THE ADVENTURE OF LIFE

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THE ADVENTURE OF LIFE

BY

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Author of "The Adventure of Death"

Grow old along with me!
The best is yet to be,
The last of life, for which the first was made:
Our times are in His hand
Who saith, "A whole I planned,
"Youth shows but half; trust God: see all nor be afraid!"

BROWNING: *Rabbi Ben Ezra.*

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PREFACE

The life of every one who will read these words has been influenced in some way by the war. It has rudely broken many old and sacred ties; it has touched with calamitous finger innumerable homes; it has altered life-long habits and shattered many a fondly cherished belief. It has introduced a ferment into human thought, and men who had accepted without questioning and with little understanding the mysteries of existence are finding their beliefs challenged and their faith shaken by the iron discipline of events. They are asking, as they watch civilization ablaze in the furnace, if there is any answer to the riddle of the universe; if there is any righteousness in the scheme of things; if there is any purpose in life: or if it is all nothing but an ugly delusion or a hideous dream.

There is a danger that some will find in a crude doctrine of materialism the sole resting-place for their feet; but the materialistic creed is a creed of pessimism — a foundation from which no useful and enduring edifice of belief can ever arise. That humanity may spring from the ashes of civilization with vigor renewed and vision purified, we must cultivate an invincible spirit of optimism. For such an attitude of mind we have good grounds: we have none for the sterilizing dogmas of materialism.

It is given to the physician to see much of human life. He has many opportunities of beholding its sordidness. He is the daily witness of its high heroism. He is con-

stantly faced by its problems; he can never get away from its mysteries; his knowledge of its adaptations is intimate, and though there is still much about it that is hidden from his inquiring eyes, he is aware of some of its potentialities.

Personally, I cannot bring myself to believe that life can ever be explained in the terms of sheer materialism, and reduced to mere chemical equations, or expressed entirely in the language of the physical or physiological laboratory. The indomitable logic of facts has driven me to the conclusion that behind all and above all there is an intelligent and beneficent Mind, immanent in nature and in the life of man. If this is true we have good reason to hail the future with a glad confidence.

The chapters which follow have been written in the hope that they may help to illumine with a ray of light, however feeble, the clouds of perplexity with which many an earnest seeker after the truth finds himself surrounded.

The book is neither a scientific monograph nor a philosophical treatise, and will be easily comprehended by all. As far as possible I have endeavored to avoid the use of technical terms. My aim has been to impress upon all who care to read the wonder and the harmony of life, and the complete interdependence that subsists between all forms of life. I believe that the goal of Nature is Life; the aim of Life is the development of Intelligence, and the object of Intelligence is a knowledge of God.

It is not my desire to disarm criticism, but some of the defects in the chapters which follow — of whose existence I am fully conscious — are due to the conditions under which the book has been composed. It was begun on a winter night in a little bell-tent in the

North of France, within sight of a horizon lit by the flash of heavy guns. More than once the hurricane-lamp had to be extinguished lest its faint light, illuminating the canvas walls, should attract the eye of some questing enemy aviator and tempt him to hurl his bombs upon the sleeping hospital. It was completed in a tent still within the zone of war, but somewhat more remote from actual hostilities. Libraries are no part of the equipment of a war hospital, and I have had no books of reference to fall back upon except a few smuggled over in my kit-bag. Napoleon is said to have carried a library through all his campaigns. An officer of the R.A.M.C. who would dare to attempt to emulate that great example would have his plans rudely frustrated by the Embarkation Officer. But the circumstances which made the task difficult in one direction made it easier in another, for the facts of war have supplied me with an unfailing source of illustration.

ROBERT W. MACKENNA.

B. E. F., FRANCE.
March, 1918.

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THE ADVENTURE OF LIFE

CHAPTER I

THE UNIVERSALITY OF LIFE

O mickle is the powerful grace that lies
In plants, herbs, stones, and their true qualities:
For naught so vile that on the earth doth live,
But to the earth some special good doth give.
SHAKESPEARE. *Romeo and Juliet.*

Nothing walks with aimless feet;
That not one life shall be destroyed
Or cast as rubbish to the void,
When God hath made the pile complete.
TENNYSON. *In Memoriam.*

LIFE is the most wonderful thing in the world. We find it everywhere, abundant, prodigal, and luxuriant. Earth, sea, and sky teem with it. The grass in the fields, the flowers on the hillside, the trees in the forest, the birds in the air, the fish in the water, and all things that creep or walk are quick with life. We turn over a stone with our stick and sack a city, for underneath it is a seething colony of ants, which scurry hither and thither in no purposeless panic, but intent on saving themselves, their young, and their hoarded food from destruction by the invader.

We look abroad and discover that wherever life could find a foothold it has established itself. There is living lichen on the rocks, and even on some bluff crag thrust

up from the earth like the shoulder of a sleeping giant we find that life has seized on every little shelf and slope where a handful of earth has lodged. Not far from where I write there is a great range of limestone hills. Their summits are crowned by vegetation of many kinds, and pine-trees stand defiant in the blast; but all along the precipitous sides, wherever niche or cranny has afforded a lodgment, some tree has grown, and, hanging between the earth and the sky, where no cragsman would ever venture to tread, it proclaims the triumph of life over death, and the urgency of nature's demand for life, and yet more life.

Life is such an urgent thing that it hastens to repair the devastation and havoc wrought by man. In the fields of Flanders and the fertile land of France the grass and the flowers are constantly seeking to hide the desolation which man has produced with his devilish engines of war. It is as though Nature shuddered at the defilement of Mother Earth and sought to cover her bruised body with pitying and flower-laden hands.

Much of the beauty of the earth is due to the life upon it. Take away all the vegetation, roll up the green carpet of the grass, throw down the awe-inspiring aisles of forest trees, and earth would become a desolate and unlovely place.

We live in a world of life. Much of it we can see with the unaided eye, but beyond the range of our natural vision there is a realm of nature in which life still fulfills itself. In a drop of river-water or a speck of road-dust the microscope reveals to us life in myriad forms, each distinct, but sharing in the one great principle which animates all living things. Every one of these infinitesimal creatures fills a niche of its own in the Universe. One may sit for hours at a time with an eye riveted to the tube of an ultramicroscope in a maze

of wonder, watching the dance of life performed by the teeming bacteria present in a minute drop of water from a stagnant pool. The field of vision is thronged by an innumerable multitude of actively moving, infinitely little living things. Some are engaged in a rhythmic dance, scarcely moving from their position. Others dart like some torpedo-craft across the field of vision, and pass out of sight. Others move with more leisurely progression like some sight-seer in an historic town; others again, with sinuous movement, ominous of evil purpose, bore their slow way across the visual field; and now and then, lit up by the reflected light, and all aglow like some barbaric princess loaded with precious stones, there swims into our ken a veritable queen of bacterial life. Royally she moves; and, as one wonders, she is gone.

All life is bound together in a community of mutual service. The master-chemist, the sun, at work in his laboratory in every blade of grass, is elaborating nourishment for all the cattle of the fields. The whole of the animal kingdom depends for its sustenance upon the green things of the earth. But the green things owe a debt to the animal kingdom in turn. The flower that pours its perfumed chalice into the ocean of the air depends upon the questing bee or other insect for that little speck of magic pollen-dust that will enable it to continue its life in another generation. The bird that tears a berry from a tree bears the seed off, and drops it perhaps many miles away, where haply it may find a resting-place and continue its kind.

All life in Nature is directed to high service, and even death helps Nature to win fresh fields for life. Much of the surface of the earth, as we now know it, once lay at the bottom of the sea. Of itself sand offers but a poor and precarious sustenance for vegetable life;

but the first lowly plant that established itself upon the sand made the conquest of the desert an easier thing for the plants that followed it. It lived a difficult existence, then it died, and its leaves and stem drooped and fell upon its inhospitable bed. But in making its sacrifice it won an empire. It imparted to the sand all the riches it had won from its life in the atmosphere, and the sterile shore was gradually converted into hospitable earth. The fertility of the earth is a perpetual witness to the rejuvenating power of death. Life feeds on death; and out of death new life forever rises. Nothing in Nature lives for its own ends alone; nothing in Nature dies without bequeathing a heritage of some sort to other things that live. Even the bacillus, man's constant and deadly foe, when vanquished by him, renders up to him spoils of war that may help him to win in another fight. For every micro-organism that is destroyed by his mechanism of defense in the body of a human being, confers upon him some fresh power, some increase of immunity that will help to protect him against a similar attack. The man who walks scatheless through an epidemic of infectious disease does so, in some instances, because there has come to him by heredity a healthy constitution; but part of his immunity is a legacy left to him by those germs of disease which, in the course of his life, have died within his body. Nothing that lives is valueless, and if only we could see the whole world of Nature spread before us like a picture and could understand all that there is to decipher, we should discover that it constitutes a great and beautiful whole in which, in spite of apparent universal struggle, there is a deep underlying concord whose aim and purpose is life — life more adaptable and more capable of progress.

All forms of life have the same physical basis, a

highly complex substance compounded from simple elements, known as protoplasm. This identity of the physical basis of life necessarily implies that life differs more in degree than in kind. We and the higher animals have more activities, more potentialities than the lower forms of life, but, being built up from protoplasm, we are cousins-germane to every roadside weed, or every flower in the field. And for this, if for no other reason, we should walk humbly.

In one of his essays Huxley pointed out a fact which must have struck any one who has ever sat on a hillside and contemplated the life around him. All the essential processes of life are carried on in silence. The cataract of the sap rising in some giant tree sends no ripple of sound into the atmosphere to call our attention to it. The branches orientate themselves so that the leaves may catch the sunlight, and the leaves carry on their wonderful work of chemical disintegration and chemical synthesis in absolute silence. The boom of the bursting bud is a poetic fancy, divorced from reality. The fruit ripens, and falls mellow to the earth, but no murmur is wrung from the parent tree. The bleat of a straying sheep, the hum of a bee, the rasping crescendo of the grasshopper, the bark of a distant dog, all come to us vibrant and keen in the stillness of nature. But they are not essential processes of the life of the creatures that produce them. They are the witnesses to the joy of life, or its perplexity.

Our muscles contract noiselessly; in the river of our blood millions of little cargo-boats collide and move on again without a sound. Organs like the liver perform marvelous functions of chemical conversion in absolute silence. A stethoscope applied to the chest enables us to hear the rhythmic thud of the closure

of the valves in the heart, and we may hear also the rustle of the air as it is sucked into the ramifying passages through the lungs. But we can detect no sound from the processes of assimilation which are occurring so constantly in the heart muscle, to keep it in repair; nor do we hear any noise and clamor that would tell us that the cells of the lungs are the busiest wharves in the world, where countless millions of cargo-boats are unloading carbonic-acid gas, and taking in a freight of oxygen every moment of the day and night.

Even thought, the highest function of which any living thing is capable, is a silent process.

The question as to whether life exists on any other planet than our own is one of constant allurement, and as yet science has no definite and authoritative declaration to make. It has been pointed out that certain very special conditions are necessary for the maintenance of life, such as an atmosphere of a certain density, containing at least oxygen and carbonic-acid gas, nitrogen and moisture; regularity, within certain limits, of temperature; an adequate amount of solar energy in the form of light and heat; and an abundance of water. These things are necessary for life as we know it. But there may be other forms of life of which we have neither knowledge nor the power to conceive. To man, to all animals, and to all vegetable life oxygen is essential. But there is a class of micro-organisms, of which the tetanus bacillus is one, to which oxygen is a deadly poison. They cannot live in its presence. They flourish in its absence. So it is obvious that the conditions which we know to be essential for the maintenance of human life upon the earth may not be necessary for other forms of life on other planets. It would indeed be strange if the infinite immensity of space, sprinkled over as it is by an incal-

culable number of worlds greater than our own, should offer no habitation to life but the surface of our minor planet, the earth.

Flammarion, the distinguished French astronomer, was convinced that life exists on other planets than our own, and many think with him. But when we remember the remarkable way in which life is affected by environment, we must be prepared to admit that any form of life met with among the stars, being subject to other influences, will probably differ in a marked degree from life as we know it.

The simplest form of life is the unicellular organism — the protozoon. Man is built up from a multitude of such cells, many millions going to make up his body. But he does not consist of a coherent mass of protozoa welded together. His cells are specialized. Some are set aside in one organ to discharge certain functions; others, in other organs, are devoted to still different ends. Complexity of organization has led to specialization of function, and the complex organism and the specialized function are integrated and controlled by the marvelously developed nervous system of which he is possessed. He is no mere collection of cells. He is a self-determined individual, sharing in common with the lowlier forms of life the power of growth, the functions of assimilation and nutrition, the power of reproduction, and participating with them in the inevitable experience of death. But he has an experience which is his and his alone. Endowed with the golden gift of reason, he is, to some extent, the master of his own destiny. For him life need not be a meaningless repetition of elementary and almost automatic functions. He may scale the dizzy heights of joy, or plumb the depths of sorrow. Made for action, eager for life, capable of self-sacrifice and of worship, ever

hungering insatiably for new knowledge, man may make of life no meaningless adventure, but a glorious opportunity.

Though a great chasm divides the inanimate things in Nature from the things that have life, Life is perpetually making use of the inanimate, quickening it to new activities. The iron of the earth, and the limestone rock broken up by atmospheric influences, are absorbed and modified by the plant life of the fields, and become incorporate in the bodies of animals, and may ascend through bird or sheep or oxen to a place in the body of man. Life spins fresh matter into her ever-growing web, and when the web crumbles into dust, Life picks up the separated atoms once again and weaves other and possibly still more beautiful webs. Matter, which some hold to be the only reality, is little more than a delusion: it becomes real only when it subserves the purposes of life.

All the forces of Nature are leagued in a great conspiracy. The sunbeam which trips daintily over a field of ripening corn, sprinkling the last flecks of gold on the tumid ears, is completing with its living touch the work made possible by myriads of dead and lowly things. Many generations of plant life perished to prepare the soil; worms and insects and bacteria have labored and died to enrich it. Winter has crumbled it in her ice-cold fingers; Spring has warmed it with her breath; Summer has sounded her réveille and marshalled the serried ranks of standing corn, teaching them to forage in the limitless acres of the atmosphere; the rain has poured out its libation, and the wind is come with a promise that the time of harvest shall not fail, and that there will be food for man and beast. For the whole Universe works together in the service of life, which is the goal of Nature and her crown.

CHAPTER II

THE ORIGIN OF LIFE

"I call the effects of Nature the works of God, whose hand and instrument she only is; and therefore to ascribe His actions unto her is to devolve the honor of the principal agent upon the instrument, which if with reason we may do, then let our hammers rise up and boast that they have built our houses, and our pen receive the honor of our writings."

Sir Thomas Browne. *Religio Medici.*

In all ages the question of the origin of life has allured and perplexed the thinking man. Unable to fathom the mystery, he has either folded his hands and abandoned his search for a solution, or he has fallen back upon his imagination, and some of the most beautiful legends of mythology were the offerings made by fancy to the clamant appeal of the hungering mind for a knowledge of the truth.

From the days of Aristotle down to our own time the idea of the possibility of spontaneous generation has had its supporters. They hold that the line between the non-living and the living, which is passed in the reverse direction by everything that breathes at death, is largely an artificial barrier, and they believe that animate things may rise spontaneously from the inanimate. The careful experiments of Pasteur did much to disprove the doctrine, but of recent years it has received a fresh impetus from the researches of Leduc, and from the observation of Burke of Cambridge, who studied the effects produced by radium emanations upon solutions of gelatine. A great body of scientific opin-

ion is, however, opposed to the possibility of spontaneous generation occurring. It is worthy of note that whenever living things are said to have appeared spontaneously they have been found to belong to animal or vegetable species which are already known. This is in itself a powerful argument against their authenticity. If spontaneous generation ever occurs, either in nature or under laboratory conditions, it would probably present us with entirely new forms of life. This would mean the constant appearance of new species, and we know that the number of species increases only by age-long variations.

Aristotle, no mean scientific observer, who studied the manifestations of life carefully and recognized the unbroken chain which links the lowest plant with the higher animals, believed that certain fishes were produced spontaneously, and Virgil, naturalist and poet, tells in his *Georgics* how a goddess taught the shepherd to cause living bees to rise from the flanks of a dead bullock. In the *De rerum Natura* Lucretius expressed the opinion that animals might develop from the action of the sun upon the vapors and moisture of the earth.

At a much later date Van Helmont, who lived in the sixteenth century, stated that living mice and scorpions could be produced at will, like the live rabbit from the conjuror's hat, by mixing together certain ingredients. His recipe for the spontaneous generation of mice consisted of a mixture of dirty linen with wheat, or a piece of cheese, while scorpions could be produced by exposing sweet basil to the heat of the sun in the hollow of a scooped-out brick. These interesting conclusions were the outcome either of inaccurate observation, or of faulty method which left a loop-hole for error to creep in — in one case a vagrant mother-mouse, in the other a scorpion. Holinshed, in whose historical works

Shakespeare dug deep for the ground-work of some of his plays, said in his *Description of England,* " A horse-hair laid in a pailfull of turbid water will in a short time stir and become a living creature." This erroneous idea still persists in some country districts.

In approaching the study of the origin of life we must not forget that the earth existed as a glowing ball of fire for many æons before it cooled down sufficiently to give to life a fit nidus in which to develop. Though some forms of life are marvelously tolerant of extremes either of heat or cold, life as a rule requires for its maintenance and propagation certain somewhat specialized conditions, and until such conditions were attainable upon our globe there was no life upon it. The late Lord Kelvin calculated that some time between twenty and forty million years ago the conditions upon the earth began to be compatible with the development of life. The margin of twenty million years between the two dates seems a generous and ample concession, though it is only a moment relatively to the immense and incalculable period since the gaseous particles or atoms of meteoric dust that were the prototype of our planet rushed to each other in the cosmic dance, and, blazing through space, Earth started on her pilgrimage along the unbeaten track of her orbit.

Before we proceed to consider how life may have come to earth we must recognize two facts. First, that life on this planet probably began in the sea, and, second, that vegetable life was, almost certainly, the precursor of animal life. The former of these postulates is founded on the knowledge that moisture is necessary for the continuance of life in its full activity, and that the sea would offer a medium whose temperature was less variable than that of the adjacent land. Further, it should not be forgotten that in the water

of the sea are found dissolved most of those inorganic or mineral substances that are requisite for the support of plant life, and the constant motion of the sea would bring the necessary pabulum to the growing plant. Vegetable life must have preceded animal life, for not even yet, after these millions of years during which it has succeeded in accommodating itself to many changes of environment, has the animal economy found a way of supporting itself directly from inorganic materials. Plant life is the jackal, it is the lion's provider: it caters for animal life, and without vegetable life, unless it suddenly acquired new powers, animal life would speedily and inevitably die out.

Probably life appeared in the sea in a form even more elementary than those simple unicellular formations such as the protozoa and the various forms of bacterial life which we know to-day. Some biologists believe that by the time the protozoon was reached, evolution had already many years behind it.

There are several theories as to the origin of life, each of which has its advocates. There is the theory that life is the result of a definite creative act of the great First Cause that lies behind the Universe. Another opinion is that life did not originate on our planet, but came to it as a rich bequest from some other world that perished years ago. In the collision or cataclysm which shattered that planet some particle of living matter, it is suggested, found refuge in a cleft in a piece of rock, and the fragment of rock, rushing through space as a meteorite, fell upon the earth and surrendered its precious burden to the waves of the sea. Both Lord Kelvin and von Helmholtz accepted this hypothesis as a feasible explanation of the manner in which life may have come to earth; but it has been opposed by other authorities on the ground that in its passage through our at-

mosphere a meteorite glows with intense heat, and consequently its temperature is raised to a degree that is incompatible with life. On the other hand it has been urged that, if the cleft in the meteorite were sufficiently deep, its little germinal burden might find adequate protection even though the surface of the meteorite were hotter than Nebuchadnezzar's furnace. It has also been suggested that life may have come to earth from some other planet without the intervention of a meteorite to carry it. Cohn put forward the suggestion that, in the cosmic dust which floats through space and falls gently as the dew upon the expectant bosom of the earth, there might be mingled living cells that had wandered or been hurled into space from some other planet. Falling gradually through our atmosphere, these living cells would not attain such a velocity that their temperature would be raised to a degree incompatible with their continued vitality. Svante Arrhenius has suggested that living matter may travel from star to star, impelled by the pressure of the waves of light. But both theories have had their opponents, who believe that the actinic rays of the sun would destroy these elementary living cells in their long passage through the vastnesses of interplanetary space.

In 1872 W. Preyer made a novel suggestion concerning the origin of life upon the earth. He was of opinion that life was present in the midst of the glowing mass of incandescent matter of which the earth consisted before it began to cool. According to his view the molten ball teemed with low forms of life which he called pyrozoa. These life-forms differed radically from any type of living thing that we know to-day in their extraordinary capacity for resisting heat. As the earth cooled the pyrozoa adapted themselves to the new conditions, and became the remote predecessors of those

forms of life with which we are acquainted. Preyer's theory did not receive much support, and to-day it is almost forgotten.

Of recent years an attempt has been made to prove that life arose spontaneously when the surface of the cooling earth was covered by chemical substances in a condition of nascent activity. According to this theory creation has not yet ceased. It is still in operation, and life continues to be engendered afresh from non-living materials.

The chemist has divided matter into two great classes — organic substances and inorganic substances. An organic substance is one which contains carbon, while an inorganic substance, such for example as sulphate of iron, oxide of lead, or bichloride of mercury, is carbon-free. For a long period it was believed that the line separating the organic from the inorganic was sharp and well-defined, and that at no point did the substances in the two classes approximate to each other in composition or character. But about the middle of the last century Thomas Graham began to investigate the properties of a series of bodies which he called colloids (from *colla* — glue) an example of which is gelatine, and he enunciated the opinion that in the colloids we have a large group of substances that come near to bridging the chasm between the organic and the inorganic. As sometimes happens with an epoch-making discovery, his work was neglected and almost forgotten, until about the beginning of the present century, when its importance dawned upon the chemist and physiologist, and the chemistry of the colloids has become one of the most fertile territories for research that the scientific mind has yet discovered. With singular clarity of vision Graham recognized the close relationship subsisting between the character of the col-

loids and the phenomena of life, and later observers have not hesitated to suggest that through the colloids one may pick one's way from the inorganic to the organic, and from the inanimate to the living.

If, in imagination, equipped with all the resources of modern chemical knowledge, we could throw ourselves back through the ages to that primeval time when the earth had cooled just to that degree of temperature compatible with life, we should find ourselves contemplating a sphere bubbling with energy and instinct with chemical change. Earth would still be warm to the touch. It would be enveloped in a thick cloud of vapor, an atmosphere saturated with moisture. As the land cooled the saturated atmosphere above it would give up some of its vapor, in huge quantities of dew or rain, as though some giant hand were squeezing the moisture from a colossal sponge. The falling water would plow channels for itself over the surface of the cooling globe, and, flowing down to the valleys, would make the lakes and the oceans, dividing peak from peak, island from island, and continent from continent. Besides carrying an excess of moisture, the atmosphere would almost certainly contain a higher percentage of carbonic acid gas than it does to-day, and be more highly charged with electrical energy. Huge volcanoes would be in active eruption, filling the atmosphere with fine dust brought from the bowels of the earth — dust charged with strange radio-active properties. The surface of the globe would be a vast chemical laboratory, where atoms were groping after atoms, finding each day new affinities stable or unstable, breaking away from old combinations at the lure of new and more efficient ones; where every gas and every element was in a nascent state, that condition in which its energy is most potent. It was an hour pregnant with tremen-

dous possibilities. We have called it an hour; it may have been an æon, for we have no means of measuring the duration of the epoch during which earth was approaching that degree of temperature compatible with the reception or development of the first living cell.

Protoplasm, the physical basis of all life, whether vegetable or animal, consists of carbon, oxygen, hydrogen, nitrogen, with traces of phosphorus and possibly sulphur. Science knows no living thing which does not consist of protoplasm.

It has been suggested that life originated on the earth in the following manner. In the primeval dawn when, as we have seen, earth was a great chemical laboratory, certain molecules of those elements we have stated to be the constituents of protoplasm united in the waters of some quiet lagoon or peaceful bay of the sea. The union would be more or less stable, and the protoplasmic jelly would tend to increase in size. Occasionally fragments of the jelly would be broken off by mechanical means, and they in turn would continue to combine with other elements and increase in size by accretion. As molecule united with molecule, it has been suggested that various unstable compounds uniting with this primitive but still lifeless protoplasm would supply it with stores of energy, the liberation of which would produce automatic movement and possibly bring about the subdivision of the formless mass. That this is no fantastic dream has been demonstrated by the fascinating experiments of Professor Stephane Leduc, who, under suitable conditions, has succeeded in producing in solutions of inorganic salts figures of growth which closely resemble plant life, and processes of cellular division that reproduce exactly the nuclear and cellular division of a living cell with all the complicated figures of mitosis.

But Leduc's beautiful figments are, after all, only phantasms of life; they are not living entities.

Similarly the carbon-containing protoplasmic jelly which we have imagined growing in some silent mist-shadowed lagoon was not a living thing. It lacked the subtle touch of the vitalizing wand of life. Whence could that come? To this the science of chemistry makes a ready answer. There are substances known as catalysers, which have the power of producing chemical changes and chemical combinations between other substances while they themselves remain unaffected. The class-room experiment with spongy platinum is well known. If hydrogen and oxygen are mixed in the proper proportion in a closed vessel they may be kept indefinitely at ordinary temperatures without any combination taking place between them. But if a fragment of spongy platinum be dropped into the mixture the two gases combine instantaneously with a loud explosion, and water is produced. The spongy platinum remains unaltered, and may be used over and over again for a similar experiment. It has acted simply as a catalyser. It has been the finger that has pulled the trigger of the gun.

Chemists have discovered several catalysing agents, and it is possible that when the world was young many substances existed with this property. So it has been suggested that one of these agents came into contact with a mass of lifeless protoplasmic jelly, containing the elements we have mentioned, and caused them to combine, linking up the molecules in such a way that they became possessed of that new, extraordinary, and unfathomable property that we know as life.

To explain the continuance of life upon the earth and its further development from the primordial mass

of vitalized protoplasm we must postulate that it did not appear till the nidus or nest was ready for it. If this first union of the elements into living protoplasm had occurred, as it might have done, at a time when the surrounding conditions were incompatible with its continuance and development the living mass would have relapsed again into an inert and lifeless condition. The fact that a specific point in time and a special concatenation of antecedent conditions was a necessary precursor of the appearance of life upon the earth should be emphasized. Its importance will become apparent later.

We have seen that the origin of life upon the earth has been explained in four ways:

1. As the result of a definite creative act.
2. By the transference of living cells from some other planet.
3. By the existence of life in a low and peculiar form (pyrozoa) in the substance of the earth while it was still a blazing cloud of gas.
4. By the union of certain elements, under suitable conditions, by natural processes, without the intervention of any outside intelligent guidance.

The first theory is the only one which insists upon the necessity of a causative and intelligent agent operating from without. It is the theory held by the Christian Church, and it has withstood a multitude of attacks from many quarters. The second theory does no more than push the difficulty a little further back. It does not pretend to explain the origin of life, but simply suggests a means whereby life came to the planet. It is not, therefore, an adequate solution of the problem with which we are confronted. If life, as we know it, came to earth from some other planet, we have a natural desire to know how it originated there. What

causes operated to bring it into being? Was it created, or did it arise spontaneously there? We find ourselves in the orbit of a vicious circle, and we have not succeeded in doing more than transferring our difficulty to another sphere, where its solution is beyond our reach.

All that need be said of the third theory is that if the pyrozoa, as Preyer suggested, were coeval with the matter out of which the earth is formed, whence did they come, and why were they endowed with life? Were they simply fragments of matter raised to the n^{th} degree?

The last theory really amounts to the statement that, given the conditions presupposed, life had inevitably to follow. It is, in some sort, a modern elaboration of a conception already formulated by Lucretius:

> "Multaque nunc etiam exsistunt animalia terris,
> Imbribus et calido solis concreta vapore." [1]

It has received a great impetus from the discoveries relating to radio-active substances, and is now held in some form or other by many scientists as offering a feasible explanation of the origin of life. But when we come to examine it critically we find that it does not carry us far enough. It deals only with secondary causes. It explains a possible method. It takes no cognizance of what lies behind the method. To reach a satisfactory conclusion we must come to closer grips with the problem. We must look deeper.

The ancient conception of matter was that it consisted of an aggregation of atoms, an atom being a particle so small that it could not be divided or cut. Two atoms unite to form a molecule; molecules unite

[1] "And now there arise from the earth many living creatures produced by the rain and the warm vapor of the sun."

and form an appreciable mass. For many long years this theory of the atom held the field. It fitted the known facts regarding matter. It "worked," and was therefore regarded as valid. But science is never content with her conquests, and however severely she may have handled the speculations of the philosophers or the conceptions of the theologians, she never hesitated to scrutinize with equal impartiality the theories which have been stepping-stones in her own progress. So she has cast the theory of the atom into her crucibles and remolded it anew. Led by Svante Arrhenius, a distinguished chemist and physicist, she has begun to wonder if matter is really the "solid" thing she imagined it to be, and is not, rather, simply a condition of motion. Bishop Berkeley long ago suggested that, apart from the percipient mind, matter had no existence. Modern science stretches out a hand to him across the centuries and agrees that matter may be nothing more than a condition of motion affecting our senses. Arrhenius' conception of the atom is that, tiny and invisible though it be, it is really akin to a planetary system. In the center is a positively charged electron; round it spin an innumerable multitude of negatively charged electrons, and the relative distance between the centrally placed electron and its negatively charged satellites and their relative distance from each other, is as great as the gulf that separates the sun from the planets and the planets from one another. It is a bold conception, with a tinge of poetic inspiration, and it has served to explain certain physical phenomena that were difficult to understand on the older theory, such as radio-activity and the emission of the cathode rays from an X-ray tube. Whether or not it will stand the acid test of time, or the scrutinizing

eye which science has already turned upon it, is as yet impossible to say. But some, who are willing to take the theory as it stands and apply it fully, have not hesitated to suggest that the whole mystery of the existence of the Universe, and the coming of life itself, may be explained by the application of this conception.

They imagine that, in the beginning, infinite space was filled by the infinite ether, still, silent, immovable. A little stress or strain appeared in the ether; it was thrown into motion; the first " atom " was formed; it became as " the little leaven which leaveneth the whole lump." And from this atomic dance in the ether " matter " as we know it was formed, and the sun, the moon, the myriad stars, and our own earth, which is, after all, only a third-rate orb in the Milky Way, came progressively into being.

The conception is a bold one, bold to the verge of unreason, but it does not explain all. It is an axiom accepted alike by the scientist and the philosopher that every change in anything previously existing must have had an adequate and preëxisting cause. Or, to express it baldly, cause must precede effect. If we are honest with ourselves we are brought face to face with the question — What started this stress in the ether? and we stand mute and perplexed till we are thrown back upon a First Cause. Both science and philosophy have an evil and inveterate tendency to rest content, when driven to the extremes of thought, with attaching a label to a difficulty and imagining that such a ritual explains it. To attribute the stress to a First Cause is to fall short of satisfying the human heart that hungers after knowledge. What is this First Cause? Is it a blind force; or some cold, aloof, impersonal abstraction like the Absolute of

the Philosopher: or a living, vivid, omniscient intelligence — eternal, omnipotent God? Blind forces, acting at hazard, do not usually produce results which are orderly and well-regulated, and which can be expressed in mathematical formulæ. The Universe is a highly complex fabric, but that part of it which comes within our ken is controlled by the operation of certain laws, some of which Kepler and Newton have discovered for us. And when our knowledge is sufficiently advanced we shall probably find that other phenomena besides those of the inter-attraction of bodies in space, and the procession of the planets, are subject to law. The Universe presents a daily and nightly demonstration of beauty, of harmony and of law, and to imagine a blind force to be capable of acting as a cause and producing such effects is to tax the credulity of the most ignorant. No blind force agitating in a tray the fragments of a jig-saw puzzle will ever succeed in putting it together. No little child, given a box of colors and the necessary brushes, could blindly splash them on canvas till a Corot stood revealed; no cascade of water, drawn by the "natural force" of gravity over a precipice, and falling through ages on a block of marble would wear it down till out of its stony hardness "*The Winged Victory of Samothrace*" or two tender palpitating figures, aglow with love, like Sinding's "*Two Human Beings*" burst on the ravished eye. We do not expect such things to happen. From experience we know that they are unattainable by such means. But still, in the face of all reason, there are some who cannot find a more satisfactory explanation for the wonders revealed to us in the Universe, and the culminating wonder of human life than the operation of a blind force.

There are many who are prepared to go so far as

to admit that, to use a figure of speech, God started the machine, but they are unwilling to accept the idea that He is immanent in the Universe, and still guides and controls its every operation. According to their belief the original stress in the ether was produced by God; the after consequences came as an unavoidable sequence. Speaking anthropomorphically, the finger of God disturbed the ether: the rest followed without any further guidance or control. To suggest this is to reduce the Creator to the level of a meddlesome boy who relaxes the brake on a chain of railway wagons at the top of a colliery bank, and, startled, sees them race down the incline, beyond control, with consequences that he can neither foresee nor direct.

If we are prepared to admit the idea of an intelligent Creator we ought to be prepared to go further, and allow that He foreknew all that would follow His first energizing touch. He saw the end from the beginning: He planned it should be so.

All this is, apparently, an unwarrantable digression from the matter in question — viz., the origin of life. But the practical application of the digression will emerge shortly. There are some who are willing to accept the idea of God as a Creator of the material non-living Universe, but who hesitate to attribute to Him, except very indirectly, the origin of life. They hold that life would come as a consequence of the interactions of matter.

A distinguished scientific investigator of reverent mind and profound knowledge — Professor Benjamin Moore — has said: "Given the presence of matter and energy forms under the proper conditions, life must come, inevitably;" and he is of opinion that "If all intelligent creatures were by some holocaust destroyed, up out of the depths in process of millions of years

intelligent beings would once more emerge." He bases his conclusions on his vast knowledge of chemistry and the properties of matter. But we must not forget that the Creative Mind which constructed the Universe endowed the atoms with whatever qualities they possess; gave to the light of the sun those marvelous powers upon which all living things depend; ruled that atom should combine with atom in certain ways; and that, if certain conditions were fulfilled, certain results would follow. If we look at things in this way — and it seems rational to do so — we are forced to the conclusion that wherever or in whatever fashion life originated, it did so with the foreknowledge, and at the behest of the Mind that molded the firmament, and at the point in time when the surrounding conditions were compatible with its continuance. If we accept this we are admitting that the origin of life was a definite creative act.

Philosophy and science may spin their webs of theory —

> "Fine as ice-ferns on January panes
> Made by a breath,"

but the theories may serve only to obscure the truth they seek to make plain. Even knowledge may darken counsel with words; but when all the mighty tomes which men have written to explain the mystery of the Universe and the fact of human life have crumbled into dust there will still remain, embroidered on the garment of Nature and picked out in starry points across the vastness of the sky, the message which all may read whose vision is unclouded: "In the beginning, God."

CHAPTER III

THE ORIGIN OF MAN

"A fire-mist and a planet,
A crystal and a cell,
A jellyfish and a saurian,
And caves where the cavemen dwell;
Then a sense of law and beauty,
And a face turned from the clod —
Some call it Evolution,
And others call it God."

CARRUTH.

We have already pointed out that a characteristic of life is its urgency, its tendency to increase, and once it appeared on earth, or rather in the water of the earth, and found the conditions there favorable for its continuance, it began to expand. In all likelihood the first cell that vibrated with being was a lowlier form than any we know to-day, but it must have had some, if not all, of the properties which we find in the modern unicellular organisms. For instance, it must have had the power of growth. Now growth, if we distinguish it from simple accretion, necessarily presupposes the power of assimilation, which is the property possessed by a living cell of taking into its interior substances that differ from it in chemical composition, and, after modifying them, incorporating them in its structure. It must also have had a capacity for renewing itself and repairing any damage which it might sustain, and, from what we know of the progress of life, we may conclude that it had the power of responding in some measure to changes in its en-

vironment. Early in the life of the cell it must have acquired the power of multiplication, probably by simple division. The reason is fairly clear. A small cell absorbs nutriment from without. Unless the amount of material excreted is in equilibrium with and exactly balances the amount taken in, the original cell must increase in size. The larger the cell the more nutriment will be required for its support. It absorbs through its surface. A point is at last reached when the single surface of the cell begins to be insufficient to absorb enough nourishment to support the organism. Either of two things may then happen: the cell may die, or it may divide into two. If the first living cell on earth had died instead of dividing, earth would, once again, have been untenanted. But we believe — and here we are not speculating, since such division has been observed over and over again — that the primordial cell divided. In this way the size of the individual was lessened, since what was one became two. When we divide an apple with a knife we increase its superficies by adding to it twice the total area of the cut surface. The result of the division of an unicellular protozoon does not give so large an increase in superficial area, but it does add considerably to the extent of the surface through which nourishment can be obtained. Life therefore becomes a simpler problem in economics for the two daughter cells than it had been for the single mother-cell. Division was to the advantage of the economy, so multiplication by simple fission became the rule for all simple forms of cell-life. In this way life increased.

The first living cell was a vegetable or plant cell, and probably it appeared in the sea. Plant life can support itself on almost any form of nourishment.

Animal life is more specialized; it requires the intervention of plant life to make much of the material upon which it feeds assimilable. Plant life performs this function for animal life because it is a great chemist, or rather, it is a great chemical laboratory in which the presiding chemist is the sun. It cannot be sufficiently emphasized that life as we know it is dependent upon the sun. The hand that with a stroke could blot out the sun, would with the same stroke extinguish all life on the earth. How much life may owe to the other planets we cannot as yet tell; but we are aware that it owes not a little to the moon, for it was that beacon which lured life out of the sea. Some moon-drawn wave, straying high upon the beach, left behind it upon the tawny sand a nucleus of plant life, and the miracle spread from the waters to the dry land. Ancient mythology tells us that Venus in all her beauty rose from the sea-foam. But the whole pageant of nature, constantly changing and constantly renewed in fresh loveliness, was also a gift from the ocean to the earth. If life had remained always and solely in the sea it would not have made the progress of which we are at once the goal and the witnesses. The simpler forms of life have remained in the sea, and most of the cold-blooded animals are found there to-day. But on the land, after the first struggle for adaptation, new conditions and new stimulants of growth were accessible in ample measure. Oxygen was procurable in sufficient quantity, and it was more easily obtainable than in the water. But life has never forgotten that the sea was its first habitat, for it cannot continue to exist without water, and all mankind, as well as all plants and animals, are still living in an ocean — the saline fluid which permeates all our tissues, and without which we should all die.

Out of the protoplasm contained in the first living cell that was stranded on the shore the sun elaborated a remarkable chemical compound known as chlorophyll. A plant grown in the dark is pale, anæmic-looking, and delicate. Its leaves are white. But if such a plant be brought from its unwholesome surroundings into the gracious presence of diffused sunlight, in a few days a remarkable change will take place. Gradually the leaves become green, and the plant loses its wilted appearance. The green coloring matter is chlorophyll. It is the handmaiden of the sun, and it is able, under the influence of sunlight, to break up the carbonic acid of the atmosphere into its constituents of carbon and oxygen, rendering the carbon easily assimilable by the plant. It is upon the carbon thus absorbed that plant life largely depends for its sustenance. It derives moisture and certain salts from the earth in which it is rooted, but the chief source of its food is the carbon of the air.

The first form of plant life that appeared on the land was probably one of the mushroom-like fungi. We speak of a " mushroom family " when we desire to indicate that the family is of recent origin and rapid social advancement. But we should not forget that the mushroom is of very ancient and honorable lineage as one of its congeners is the oldest stock on the earth.

Long after the fungi appeared upon land there came the flowering plants. They represent a step much higher up the evolutionary ladder. They are vegetable life specialized for reproduction. They are more adaptable to various environments, and are endowed with properties which permit of their spreading everywhere.

But before the flowering plants came it is probable

that animal life had begun to appear. The ubiquitous microbe represents a stage somewhere between vegetable and animal life. It has not yet been decided whether microbes should be regarded as belonging to the animal or vegetable kingdom, though the weight of opinion tends to consign them to the latter. They contain no chlorophyll, and therefore are unable to derive the nourishment they require from the air. If the conditions under which they are placed are satisfactory they have a capacity for extremely rapid multiplication. It has been calculated that if a cholera bacillus is supplied with a suitable pabulum and kept at a suitable temperature it will, in the course of twenty-four hours, have over fifteen hundred trillion descendants. The figure is a staggering one, and helps to show that, if man had not the means of destroying such a menace, the micro-organism, and not the human being, would be master in the world.

Long after the earliest forms of bacterial life appeared the first protozoon came into being. It was a gelatinous mass of protoplasm, probably without any enveloping membrane. It was something more than a plant: it was something less than an animal. Slowly, by gradual changes, the line of demarcation between plant and animal forms was determined, and the sea began to have two varieties of inhabitants resembling each other, but far from identical. As the years rolled on there appeared creatures of the jelly-fish type, sponges, sea-anemones, sea-bears, star-fish, Nature early showing her love for opulent and progressive variety. Later still came the molluscs, creatures that could accommodate themselves to conditions either within the water, their natural habitat, or upon the gray and gnarled surface of the rocks when the waves temporarily receded. Then came the sea-crea-

tures with jointed limbs, the crabs, the lobsters, and the sea-insects. It has been calculated that, about the time when the marine animals had reached this stage, vegetable life had established its first footing upon the land. After the lobster class came the fishes, at first with incomplete skeletons, and later, after the lapse of many centuries, more perfect fishes with a complete osseous framework. Then came the amphibians, creatures at home alike in the water and out of it, and animal life stepped ashore. About this time, it is estimated, the flowering plants had been differentiated — a graceful coincidence which enabled Nature to deck herself with flowers to welcome the new-coming guest. These primitive amphibians were the advance-guard of animal life upon the earth. Ungainly creatures with four limbs adapted either for swimming or for walking, they spent their early life in the water breathing through their gills, and lived in their adult stage upon the land, making use of specially developed lungs for the purposes of respiration. Once established upon the earth, the amphibia rapidly increased in variety, diverging in various directions. At one time they constituted a very large class: now, their position in the animal kingdom is a subordinate one. One may well imagine that the raucous clamor of frogs in the night is their age-long protest against the forgetfulness of man, who rarely remembers that it was one of their ancestors who boldly set his life upon a hazard and ventured to come ashore.

After the amphibians came the reptiles, and it is singular that the birds, which every one loves, are descended from the reptiles towards which every one feels a constitutional repulsion. The mammalia, the great class to which all human beings belong, probably appeared about the same time as the

birds from some reptilian stem. The mammals multiplied rapidly, became differentiated into many groups, and at last the summit of the long ascent was reached in the development of man.

Such is, in brief, a cursory account of the genesis of man according to the evolutionary doctrine. Long ago Aristotle pointed out how very closely all forms of plant and animal life were related to each other. In the eighteenth century Bonnet added to our knowledge of the relationship of animals one to another and tried to trace an unbroken sequence of development from the lower animals to man. Lamarck, perplexed by the difficulty in differentiating species, called attention to the possibility of variation impressed upon the individual being the determining factor in producing new species from a common stem; but it was left to the genius of Charles Darwin to point out that in natural selection lay the key to variation, and the solution of the problem of the origin of species. With infinite patience, touched with the spirit of genius, and with that reverence which is almost invariably a characteristic of the truly great mind, Darwin worked out his theory carefully, showing that behind the principle of selection lay another principle, the survival of the fittest. Capacity for adaptation to the requirements of new environment, and the relentless extermination of individuals and species that lacked this faculty, had led to the continued existence of certain varieties of animal and plant life, and the extinction of others. If Darwin had been left to champion his theory alone it is unlikely that it would have provoked as much hostility as it did; but he was badly served by some of those who seized upon his hypothesis and flung it rudely in the teeth of many a fondly cherished belief.

Haeckel, with prodigious energy and Teutonic thoroughness, has traced with care all the evolutionary steps from the lowest form of life up to man, illustrating his narrative by constant reference to members of the various groups that still survive as inhabitants of the earth, the air, and the sea. He has laid special emphasis upon the fact that ontogeny, which is the science of the development of the individual, is a condensed epitome of phylogeny, or the history of the development of the species, and he has applied this doctrine to the life-history of man. It cannot be denied that much evidence may be adduced in support of this opinion. Starting from the embryonic primordial cell, which resembles a protozoon, the human off-spring, in the course of its antenatal growth, passes through many stages which closely approximate to various lowly forms of animal life. At one time it is more like a multicellular protozoon — a mere ball of cells — than a human being; at another it suggests a worm-like creature; later it has many points in common with the fish; and later still it is more like an anthropoid ape than a child of man. So that, apparently, every child climbs its own evolutionary ladder in the space of a few months, covering the ground in its brief antenatal existence which it took its ancestor, the first man, many million years to traverse. But it must be clearly understood that at no point, were the development of the human embryo arrested, could it be deflected into a worm, a fish, or an ape. Humanity is impressed upon it from the beginning.

It must not be forgotten that the doctrine of evolution is still a hypothesis, but it is a hypothesis so well supported by accumulated evidence as to have become to all intents an established fact, and only

a very few now question its validity. One of its most characteristic features is its fairness. It offers a logical explanation, not only of progress and survival, but also of failure and extermination among the various species of living things. One may attempt to draw a picture to illustrate the evolutionary principle in action; but no scheme mapped out with ordinary lines can give a correct idea of how progress has been achieved, not constantly and rapidly, but little by little, by a hard-won step forward here, a retrogression there, the possible blotting out of a promising line at one place, and the coming into prominence of another elsewhere. The spectacle is a dramatic one, and only a genius could have recognized it.

Emphasis is too often laid upon a wrong view of the struggle for existence. The battle has not always been to the strong. Species of animals that, in virtue of their weapons of offense and defense, and their gigantic muscular development, ought to have survived if the struggle had been one of brute force and brute force alone, are altogether extinct. When one studies the matter closely, one is led to the conclusion that it is not brute strength which is the aim of life, but the development of mind. Most, if not all, of the creatures that have survived to our day have won through because of some little advantage in instinct or intelligence. If we give due weight to this aspect of the matter we shall, I think, be able to overcome one of the chief practical objections that has been advanced against the doctrine of evolution, namely, the almost incalculable length of time which the process of evolution requires. Morphological and structural changes brought about by environment are very slow to appear and to become established in the stem of

the species. But instinctive or intelligent adaptations would beget new functions; and function can rapidly alter preëxisting structures for its own ends.

A widespread misconception regarding evolution is that it claims to prove that man is descended directly from some living form of ape. This idea has produced a sense of revulsion in many minds; but it is quite erroneous. Certainly man is derived from a common stem with some of the apes, but in the remote antiquity of prehistoric ages; and since he left the stem he has developed steadily along his own specialized line, while his ape relations have lagged behind. If one may be allowed to make a comparison, one might say that the common fount of life is like an immense lake high up between two guardian hills. From one end of the lake two streams escape, which represent the plant stem and the animal stem. If we follow the animal stream we discover ere long that it is giving off little branches. There are branches to represent the jelly-fish, the vertebrate fishes, the amphibia, and so on. After traveling for a short distance a very large daughter stream breaks away, and when it has flowed for a little space it is divided into two rivers by some intervening rock upon the hillside. One of these rivers represents the ape stem; the other is the stream of the human race. Though now separated from each other, they travel on side by side through many an unmeasured æon, parallel but divided, taking up from their environment this and that quality, deflected here, steadily progressing there, and always moving onward. As they flow on they begin to diverge, and the human stream gradually acquires a greater velocity than the ape stream and passes on far ahead of it into the limitless valley of opportunity, while the ape stream lags behind, held in the tangle

of a morass. This is a truer and a less repulsive picture of the evolution of man than that disordered dream which imagines that he has sprung straight from the loins of an ape, and, taking to the trees to ensure his safety against some rapacious beast, has sat in the attitude of Rodin's " Thinker " until his caudal appendage atrophied from disuse, and the hair fell from his body through much cogitation.

Modern opinion has modified somewhat the views held as to the factors which produce evolutionary changes. At one time it was believed that the chief variations were due to external causes such as environment. Now, many hold that besides the influence of environment we must take account of influences working from within the organism outwards. In his *Last Words on Great Issues* Dr. Beattie Crozier says: " Whatever subsidiary influence the environment may have had on the evolution of the forms of plant and animal life, an inner organizing principle which keeps possible variations within strict and definite limits, not to be overborne, must be assumed as primary and fundamental."

It is altogether wrong to imagine that the influence of the directing Mind behind the Universe is ruled out by the evolutionary theory. To discover the plan on which a great cathedral has been constructed is not to dispense with the architect and the builder. The Mind responsible for those chemical affinities and molecular combinations which resulted in the appearance of the first living protoplasmic cell was also responsible for endowing the protoplasm with the power of adapting itself to its environment. So far as we can judge of any of His operations in nature, the Creator invariably makes use of what we call secondary causes. He is throughout self-consistent, and Darwin's demon-

stration of man's evolutionary ascension should not shake the belief of any one in the overruling and controlling influence of the Mind which fore-ordained and foreknew that out of the speck of protoplasm in the lagoon at the foot of the hill creature after creature should evolve, and, molded by environment, struggle on, until at last man should stand erect upon the summit.

CHAPTER IV

THE DOMINANT RÔLE OF INTELLIGENCE IN THE EVOLUTION OF MAN

"Mind is not matter nor from matter, but
Above, leave matter then, proceed with mind!
Man's be the mind recognized at the height;—
Leave the inferior minds and look at man."
ROBERT BROWNING. *The Ring and the Book.*

WHEN one surveys the geological records of the history of life upon the earth one discovers that many animals and many complete species are now extinct. Some of these animals were gigantic creatures, like the iguanodon. Others, like the saber-toothed tiger, possessed weapons that should have served them well in the struggle for life. But the ichthyosaurus, the diplodocus, the dinotherium and the mastodon have all vanished, leaving no record except a heap of bones, or the impress of their skeleton in a rock that was once clay, from which the scientist has been able to reconstruct models bearing some resemblance to their ancient prototypes. Those species which have survived owe their survival to peculiar faculties of adaptation to changing circumstances, to the possibility of acquiring adequate food, and to the possession of one or other characteristic that enabled them to defend themselves. The tortoise has survived probably because it was provided with a carapace, a shell-like osseous roof under which it could hide itself; the elephant owes its survival to its strength, its swiftness, its intelligence, and the fact that, unlike the mammoth, its body was not out of proportion to the amount of food it could acquire; the lion and the tiger owe their sur-

vival to their strength, agility, claws and teeth, and to their courage and cunning, which are mental qualities; while the venomous reptiles survived because of their poison-glands.

In the whole history of mankind there is no moment more dramatic than that in which man first found himself alone in the world of monsters. Naked and unarmed, physically inferior to many of the animals around him, with neither rending tooth nor tearing claw, he was to all outward appearance at a tremendous disadvantage. But he was, even in those primeval days, a creature of immense potentialities. He did not skulk and hide like some craven afraid to face his destiny; but he raised himself on his feet, stood splendid in his manhood, and dared to look with undaunted eye on the world before him, with some faint glimmering in his mind of the consciousness that to him it was given to be a king.

Structurally he was intimately connected with the whole vertebrate kingdom around him. He had not a bone or a muscle, an organ or a sense which was not already typified and existing in some of the animals amongst which he found himself. In the mammalian kingdom the resemblance between himself and the other members became closer and closer. Bone for bone, organ for organ, sense for sense, he resembled them so closely that among the higher apes creatures were to be found that anatomically and morphologically could hardly be distinguished from him. As has already been pointed out, when one reviews the whole panorama of living things one finds that through it all runs a great and almost uninterrupted principle of continuity. It is a far cry from the unicellular protozoa to man; but right up, through the long ladder, there is a series of intermediate steps which proves his

intimate relationship with the whole world of living things. Then near the top of the ladder there comes a long and impassable gap. Anatomically the gap is negligible; but mentally it is insuperable.

The central nervous system of man resembles closely that found in the higher animals. They have the same senses, often better developed than his own. He has not the vision of the eagle or the hawk, nor are his senses of smell and hearing developed so highly as they are in the dog. But the functions of his brain are of an infinitely higher order than those possessed by any other animal, and it is in the domain of function rather than in that of morphology that the chief differences between man and the animals are to be found. Haeckel, in reviewing the results of anthropogeny, said: "Within the limits of this small group of animals [the apes of the old world] we found the structural differences between the lower and higher catarrhine apes — for instance, the baboon and the gorilla — to be much greater than the difference between the anthropoid apes and man."[1] But we must be careful to note that this statement only holds good if it is limited to anatomical details. It has nothing to do with the matter of intelligence. There is a huge gulf between the intelligence of the highest anthropoid ape and the lowest type of the human species. At its worst, provided the underlying brain is sound, the latter is progressively improvable; the former remains stagnant. In man something has been superadded. He is become a living soul, quickened to a larger mental and spiritual life by the breath of God.

Some physiologists are prepared to go the length of saying that there is an unbroken continuity of nervous function which links the lowest living creature

[1] *The Evolution of Man,* chap. XXX.

with man, the highest. They suggest that the chain begins in simple reflex actions, such as the protrusion or withdrawal of a protoplasmic offshoot from the amœba under the influence of a stimulus, and proceeds gradually up to the higher psychic operations of the human mind; and in recent years an attempt has been made to discover in the tropisms of plants and animals the roots of the instincts, habits, and conduct of all living creatures, including man. A tropism may be defined as a simple response to an external stimulus. Most flowers turn to the light: they are helio- or phototropic. Moths and flies are phototropic; a worm, on the other hand, shrinks from the light: it is negatively phototropic. Lowly organized animals are led by a chemical impulse to their food. They are chemotropic. The branches of a banyan-tree turn to the earth: they are geotropic. The explanation of these phenomena has been found in chemical activity. When light falls on a moth it is said that certain changes occur in its body. These chemical changes stimulate muscular movement. Without any will of its own, the moth is driven by the reflex beating of its wings straight to the source of light, and perishes in the flames.

These are interesting and seductive theories, and from them has been built an elaborate superstructure of hypothesis that would gladly claim as its coping-stone the complex manifestations of the intelligence of man. But, in man, thought and conduct cannot be reduced to purely physico-chemical changes in nerve-cells. As the physiologist advances his claims, the psychologist seems sometimes to abandon his positions with undue haste. Even when the physiologist has been able to see and determine the precise chemical changes which occur in the cells of the brain during

an act of thought, he will not be any nearer the solution of the matter. Brain changes probably do accompany every act of thought, for the brain is the physical organ of the mind. But the mind is not the brain, and no physico-chemical account of the metabolism or katabolism of nerve tissue will ever explain the genesis of an abstract idea, or account for a conception of moral right or moral wrong. One must ever guard against confusing a psychic act with its physiological concomitants.

It has long been the custom to deny intelligence to the lower animals, and to confine any mental life of which they are capable to the domain of instinct. I do not feel we are justified in thus restricting their mental activities. Any one who has read Fabre's marvelous records of his studies of insects must forever feel a difficulty in drawing a hard and fast line between the manifestations of instinct and the operations of intelligence. And we cannot fairly deny to some of the higher animals a few of those qualities of mind that are often regarded as the prerogative of man. For instance, who will deny that a fox-terrier or a collie is capable of showing affection, fear, and memory, or that a sheep cannot express in its agonized bleating some shadow of the emotion of love for its offspring. I remember, as a little child, hearing all day long the plaintive bleating of the lambs that had been separated from their mothers and driven up to the high pastures in the late days of July, and the responsive, deeper-toned calling of the ewes in the lowlands, as they wandered nervously and perturbed about the field in a vain endeavor to get back to their young. There was some other note in the crying of the lambs than a mere desire for food, and there was more in the mothers' tremulous response than the pain

of an overfilled udder. It was the oldest and biggest emotion in the world; and, with the clear intuition of a little child, I heard and understood.

We cannot by an arbitrary and hard and fast decision deny intelligence to all the lower animals. The greater part of their lives is, certainly, controlled by instinct, or unreflecting impulse to action. But man also lives much of his life instinctively: he, too, acts upon impulses which he does not weigh or analyze, so that, at certain points, the mental life of animals and the mental life of man come into close touch. But there is a great difference. A fundamental distinction between instinct and intelligence is that the former does not enable those creatures whose sole guiding light it is to adjust their conduct in such a way as to deal with unexpected and unwonted experiences, while the latter helps those that possess it to do so.

Not long ago I had the opportunity of observing this difference in operation. I saw a long line of caterpillars, which had just emerged from the nest in which they had been hatched, crawling down the trunk of a tall pine-tree. There were 156 caterpillars in the procession, and they were progressing in single file, each head in contact with the posterior extremity of the one immediately in front. The long row of caterpillars suggested a line of railway carriages coupled together. By way of experiment I removed two caterpillars from the chain, and watched to see what would happen. Obviously this was an experience which must have been met with by many generations of their ancestors, for their instinct, which is automatic habit ingrained in the species through custom, taught them how to deal with this emergency. The last caterpillar at the upper end of the lower half of the broken line ceased

moving. Apparently it knew that the caterpillar which had been clinging to its tail had lost its hold. Rapidly a message passed along the line, and soon the lower half was stationary throughout its whole length. The leader of the upper half, robbed of his guide, instinctively moved his head from side to side, making the arc of a small circle as he continued to crawl down the tree-trunk. In this way he made sure of not missing the tail of the rearguard in the lower half of the procession if it should come anywhere within the arc of the circle. In a moment or two, during which time the lower column remained at a halt, the upper and the lower line succeeded in getting into touch, and the whole procession at once began to move again. Instinct had enabled the creatures to overcome this difficulty, which must many a time have called for a solution from their ancestors. When the leader of the reformed train reached the ground he set off boldly, with his followers in single file behind him. Near the tree there was a small slope, about four inches high. Down this he moved, and then, making a detour, proceeded to describe the arc of a circle in his progress. Unfortunately the rate at which he was leading the van brought him back close to the tree just as the last caterpillar was crawling from it, and the head of the leader came into contact with the body of the last of the line. Originally, as the ribbon of creatures came down the tree, these two were some twelve feet apart. Now they were touching each other, and by that instinct which apparently drives a migrating caterpillar to attach itself to the terminal extremity of any other caterpillar it comes across, the first laid hold of the hinder end of the last, and a rough circle was completed. This is probably a rare and unusual experience in the life-history of a nest of caterpillars, and

ancestral tradition had not supplied them with any means of recognizing that something was wrong, nor endowed them with the instinct necessary to deal with such a contingency. Intelligence would have supplied a solution: for instinct, there was none; and the tortuous circle continued to move round and round, making no progress, for nearly two hours. At the end of that time exhaustion, and possibly the cold wind which had sprung up, brought the circling ribbon to a halt. Then one caterpillar rolled over. This was an accident, and not an instinctive act, as it happened to have halted on the slope already mentioned. As it rolled over, the pull of its separation caused several more to lose their balance, and they tumbled over as well. It is said that the occasion frequently makes the man, but this time it did not make the caterpillar, for, though the circle was now broken the caterpillar at the head of the line did not rise to the height of his opportunity and assume the rôle of leader. Instead, he remained still. After a time other breaks occurred in the line, but not one of the creatures assumed any directive powers. Instead of being a communal society with a definite end in view, this collection of caterpillars became an impotent crowd. As they crawled about, apparently without any determined aim, singly or in couples, they met other members of their family; but no attempt was made to reform the line, and when they came in contact they remained huddled together in a confused heap, perplexed, baffled, and beaten by the first problem in their adventure of life. They presented a singular and instructive example of the limitations and insufficiency of unaided instinct. Next morning many lay dead. A few robust survivors had succeeded in taking to earth under some loose sand. The dead lay there as a witness to that

provision of nature by which those creatures endowed only with instinct are produced in enormous numbers so that the inevitable casualties which must come to them through their lack of intelligence may not lead to their total extirpation.

Intellectually the lowest member of the human species is infinitely superior to the highest animal, and it is to his intelligence that man owes his survival. Though he was not provided by nature with weapons of defense other than his hands, he had the intellect which enabled him to fabricate weapons and tools. He was sufficiently intelligent to plan and carry into effect a combined offensive with bow and arrow, club and spear, and catapult, against those animals that lay in wait to destroy him. There is no exact parallel to this in animal life. A tiger may lie in wait for its victim, or a pack of hungry wolves may band themselves together to pursue a fleeing horseman; but no animals have ever taken counsel together to plan a campaign against the human species, to arm themselves with special weapons, to devise strategy, and so to arrange their tactics as to meet possible contingencies. It was man's intelligence, and not his brute strength, which made him a doughty opponent.

It taught him not only how to slay those wild beasts that would have slain him, but also how to establish a growing ascendancy over the less ferocious creatures. Those that could be of use to him he captured and trained. He made beasts of burden of the horse, the mule, the ass, the camel, the elephant, and the ox. Then he learned what vegetable foods were necessary to sustain life, and he found that it was easier to transplant and cultivate them than go to seek them far afield when he required them. No animal has ever shown exactly this kind of provision, even though

the ants keep dairy farms of *aphides* to supply their young with "milk," and some wasps keep a larder filled with insects which they paralyze, but do not kill, with their stings. But no animal has ever cultivated a garden to give itself sustenance.

Over all animals man has a great advantage. He is able to make use of the accumulated experience of his predecessors. The comb of the bee and the social life of the ant are, so far as we can tell, the same now as they were a million years ago. Certainly they have not altered within the memory of man. It may be that the hexagonal formation of each cell in the comb, and the communal laws that regulate the life of the ant are, for their purpose, perfect and require no alteration. But such permanence and unchangeability would not suit the restless intelligence of man, who is ever seeking to alter, adapt, and improve. Generations of animals come and go, and, except in so far as it becomes ingrained in the stem of the species, leave no record of experience from which their successors may win profit. But no generation of men vanishes from the earth without leaving some tradition, either oral or written, which may be of service to those who come after. Thus it is that man's progress has been rapid. Each successive generation has laid up for it a well-stored depository of experiences which enables it to begin where its predecessor left off, and it is man's intellectual capacity for making use of these hoarded experiences which has helped to lift him to the position in the animal kingdom which he occupies to-day. All this would have been impossible if man had not had the gift of speech. To this gift of speech Max Müller attributed the highest importance. According to him, "The one great barrier between the brute and man is language. Man speaks; and no

brute has ever uttered a word. Language is our Rubicon, and no brute has ever crossed it." This is, perhaps, a somewhat strong declaration. We may not be able to write down and classify the calls of the birds, and the different tones in the bark of a dog. But any attentive student of nature will at once admit that there is a difference, appreciable by their kind, in the quality of the love-call of a bird, and the plaintive note of one whose nest has been robbed; and there is a lively distinction between the bark of a dog which is angry and that of one which is barking from the sheer joy of life. But, be that as it may, speech, which is a gift of the intellect, has been of incalculable value to man. It has enabled him to express himself, to communicate his experiences, to cultivate social intercourse, to guide and instruct those who follow him. And though, undoubtedly, example is better than precept, a little precept is sometimes needed to call attention to the example. The power of speech was, probably, in some sort, man's from the beginning. At first it would be little more than a medley of imitative sounds; but from that point the human vocabulary would rapidly grow by diurnal accretions, by the addition of names applicable to articles of food, and the thousand and one things with which man came into contact in his daily life. Later, it would be enriched by terms applicable to abstract qualities, until the mouthful of onomatopœic words with which he began to express himself had grown into an opulent medium through which a Shakespeare could express all human laughter, all human aspiration, and all human tears.

In virtue of his intelligence man's conquests continued to extend. Some of the forces of nature he made his vassals. He captured the wind in the sails of his boats, and he made it turn his millstone. He

also made use of the power of running water, harnessing it to his own ends; and he discovered how to light a fire and keep it burning. An ancient fable of mythology tells how Prometheus stole fire from the gods, and as a punishment was condemned to a cruel and enduring torture. The fable had its roots in the wonder of primitive man at the miracle of fire. A power so strange must originally have come from the gods; it could not have been born on earth! It would be interesting to know how man first discovered fire; whether it came from the lightning and set some primeval forest ablaze, whether it poured in burning lava from some volcano, or whether, like so many other revolutionary discoveries, it came by what we call accident. But, however it came, the man who first recognized even in a remote way its value and its infinite possibilities was a genius — the lineal ancestor of Galileo, Newton, Kepler, Kelvin, Madame Curie and Marconi. The first man who rubbed two sticks together till one of them glowed made possible the railway train and the Atlantic liner. It was a great feat of intelligence to recognize the potentialities of fire. No animal, below the level of man, has ever done that. Many animals will warm themselves before a fire, and appreciate the benefits that flow from it; but no animal, less than man, has ever succeeded, by taking thought, in producing a fire, or even in keeping a fire burning once it has been lit. The early date at which the value of fire was recognized by man proves that, even in primeval times, there were men of genius. Man's intellectual capacity has changed but little in the ages. The quality of mind was there from the beginning. Much of our recent progress in the field of intellectual accomplishment is due, not to any modern superiority in mental equipment, but to the fact that nowadays

the mind has more to work upon. It has more accumulated observations from which to start; more accessories to help towards fresh conquests. In these days we can call to our service invisible forces such as electricity, or the emanations of radium, and we flatter ourselves that our intellects have enabled us to secure great triumphs over the secret forces of nature. And we are right to do so; but, in taking credit for our age as a golden era of discovery, we owe a grateful and appreciative thought to the genius of the cave-dweller who first taught his fellows the secret of fire.

Mind has always been true to itself. As far back as we have any record we find that man was directing his intellectual powers to the study of the Universe. He was groping through the mysteries toward the light. Much of the work of the Chaldean astronomers, and the science of the Chinese, Indians, and Egyptians, is lost in the mist of unchronicled antiquity. But enough has come down to us to show that, even in those remote ages, man was using his intelligence to question the infinite. He was seeking to understand; and though many of the ideas formulated by those early scientists seem to us, in a more enlightened age, absurd and fantastic, they were, in some sort, the foundations of that edifice of knowledge in whose shadow we live to-day.

His intellectual superiority is the great factor which differentiates man from other animals, and it is the chief cause of his evolutionary progress. We cannot deny a measure of intelligence to some animals, but there is a profound difference in degree, and an immense and almost incalculable difference in quality. Whatever mental life the brutes possess tends to remain stereotyped. Their intellectual development

soon touches its zenith, and remains fixed. In man the intellectual powers, great though they were in the beginning, are improvable as well as progressive. There is no standing still. The individual mind improves, the intellectual life of the race progresses. The intelligence of the brute and the intellect of man are both stable, but in a different sense. The former is stable like a rock set in the mountain side: the latter is stable like a swiftly moving aëroplane. One is stagnant and uniform; the other is in a condition of progressive movement. This gives to the mental life of man an indefinite potentiality. All his abiding triumphs are due to his intelligence. It has taught him to cultivate the earth; to win from its heart metals with which to fashion weapons and tools; to make implements; to invent machines; to employ the forces of nature for his own purposes; to defend himself against the attacks of animals larger and stronger than himself. It is strange that the only beasts of prey against which civilized man now requires to guard himself are the infinitely little ones — the microbes of disease. But by the application of his intelligence he is daily making further conquests over their domain, and in the fullness of time he will doubtless succeed in protecting himself against their attacks, however subtle.

To the intelligence of man we owe all we know of science, and all the arts we practice. It has helped him to read some of the laws by which our little corner of the Universe is governed; and it has enabled him to conceive of infinity in time and space, that colossal mystery of unbeginning and unending duration and immensity that he can guess at but cannot understand. And because he is gifted with intelligence he has been able to speculate on the past and the future

of his kind. He can appreciate the ideal and has elaborated social and moral schemes whereby to increase his own happiness, establish his security, and help himself and those who follow him along the path of progress. It is not alone through the treasures of inventive genius which one generation bequeathes to another that man progresses. His most rapid progress is attributable to the fact that the mind-culture of one era passes on to the next. Anatomical and morphological changes may require a million years for their development; social and cultural changes may be impressed upon the individual and established in the race within a life-time. And it is this adaptability, this acquisitiveness of new culture and new ideals which confers on the human mind one of its most infinite potentialities.

His mental faculties have enabled man to evolve a philosophy to explain existence; to recognize moral duties and to appreciate moral values. Intelligence has been the chief factor in hastening his development, and it is only when he is false to the light of intelligence that man sinks to the level of the brutes. Long ago, if he had followed the guidance of intelligence, he would have learned that war is a hideous wrong, morally as well as from the point of evolution. In these civilized days it is an offense to God, and its continued existence depends on a crude misinterpretation of one of the doctrines of developmental progress. There is little doubt that when Germany, for more than forty years, was steeling herself and preparing for the great conflict in which we are now engaged, she was basing her policy upon a wrong idea of the "survival of the fittest." Although one of the most intellectual nations in the world, she failed to recognize that the doctrine of the survival of the fittest does not mean

that in days past one species set itself against another to conquer or to exterminate. Such are the bald terms of her interpretation. Rightly understood, and as Darwin understood it, the principle means, simply, that those species survived which were most capable of adapting themselves to their circumstances. It never meant internecine and bloody warfare between species and species. War is retrogressive and anti-evolutionary because it brings premature death to many of the finest of a race, and tends to leave to the weaklings the continuation of their kind. As waged now, with long-distance artillery, machine-guns and rifles, it is more opposed than ever to the principles of evolution. Evolution has worked by and towards intelligence. But a shell fired by a stupid soldier whose only knowledge is the art of war, or a bullet from the rifle of a simple village lad, may kill a potential Shakespeare, a Newton or a Darwin. In so far as it makes brute force rather than intelligence the chief weapon in its offensive, it is false to all ideals of national progress. In days past, one race of men established its ascendancy over another by virtue of its higher brain power. It was brain power, and not brute force, that was intended to be the discriminating factor between the different races of mankind. And there is little doubt that if Germany had relied solely upon the intellectual activities of her people, devoted to the study of science, the application of scientific methods to manufacture, and the intelligent fostering of commerce, she would in a generation have established for herself that ascendancy among the nations that has been her ambition. Instead of this peaceful conquest, which was within her grasp, she has put back possibly for centuries the hope of realizing her dream.

CHAPTER V

THE PROTECTION OF LIFE

"There are more things in heaven and earth, Horatio,
Than are dreamt of in our philosophy."

SHAKESPEARE. *Hamlet.*

IN a poetic hyperbole Tennyson spoke of Nature as "red in tooth and claw with ravine." She is, however, the universal mother, and within her domain the balance between life and death is held firmly, with a bias toward the side of life.

To ensure the continuation and increase of their kind, many animals are endowed with the most extraordinary fertility. This is more particularly true of the fishes. Every female herring is potentially the mother of an incalculable number of offspring, and it has been estimated that a couple of cod-fish allowed to breed perfectly freely would, if all their progeny came to maturity and multiplied at the same rate, fill the sea in less than ten years with a solid mass of fish. The more highly specialized an animal becomes the less is its fertility. The horse is much less prolific than the rat, and the cow than the rabbit; and the fecundity of human beings, which is potentially very considerable, is comparatively limited. Two principles seem to underlie the law that controls fertility. Animals whose offspring are subjected to great risks are very fertile, so that, in spite of all accidents, a sufficient number of young may survive to ensure the continuance of the species.

When the dependence of the offspring upon the parents is prolonged, as is the case in the human species, fertility is sharply controlled. Once life has been achieved it is protected, and the devices whereby this protection is ensured are among the most beautiful and remarkable features of nature. Frequently the protection begins while life is still in the potential stage. We find an example of this in the protective coloring of the plovers' eggs, which are hardly distinguishable from the shallow bed of soil and débris on which they are deposited. A casual wanderer through an April field may pass many a clutch of plovers' eggs without detecting them.

The young of many sea-birds resemble their surroundings so closely in color as easily to escape the eye of the fowler or the marauding bird of prey. Many insects, too, have the advantage of protective coloring, so that they seem to be a part of the plant upon which they rest or feed. Some butterflies have wings so perfectly tinged and so exquisitely veined that they are distinguished with the utmost difficulty from leaves. Certain insects, perfectly innocuous and not provided with any weapons either of offense or defense, escape destruction because they resemble closely insects armed with powerful and painful stings. The principle of protective coloring is also met with among the higher animals. The mice of the Sinai peninsula are fawn-colored; the fur of the hares on the granite hills of Galloway turns to a silver gray in winter time; and the striped markings of the zebra enable it to escape detection among the long grasses of its natural haunts. Protective coloring is only one of the many artifices employed in nature for the preservation of life. The offensive odors of the skunk and the musk-rat are protective devices. The exigencies of modern warfare

have compelled our Navy to take a lesson in protection from the well-known artifice of the cuttle-fish. This creature, when pursued by some carnivorous monster of the sea, endeavors to elude its enemy by discharging an inky fluid which acts much in the same way as the smoke-screen with which a merchant-vessel or even a torpedo-boat envelopes itself in the endeavor to ward off the attack of a submarine or other hostile craft. The whole science of " camouflage " is a war-time elaboration of observations derived from the study of protection in nature.

But, interesting as are the protective devices met with in the lower realms of nature, it is when we approach the study of defense in the human economy that we discover phenomena of singular complexity and extraordinary efficiency.

The whole mechanism of the human body seems to have been elaborated with a special view to the protection of the life which animates it.

The chief organs necessary for the maintenance of life are protected by walls of bone. The brain, the most important organ, is walled in by the skull; but, in addition, it is covered by three membranes of varying thickness, the outer of which is distinctly protective in function, and it is, further, surrounded by a thin layer of fluid, which, in addition to other functions, acts as a cushion that not only absorbs the violence of any blow applied to the skull, but also distributes it so that the force of the impact is not localized.

The spinal cord, the great distributing tract for nerve energy and the channel by which nerve messages from without reach the central nervous system, is also protected by bone, as it runs down from the posterior part of the brain through a tunnel formed by the bodies and arches of the vertebræ. In front it is

guarded by thick and strong masses of bone — the vertebral bodies; laterally and posteriorly it is protected by the neural arches, reinforced by tough ligaments and massive muscles. Between each vertebral body is a cartilaginous buffer, the inter-vertebral disc, which absorbs shock, and prevents the base of the skull from being shattered by the impact of the vertebral column when a man falls from a height upon his feet.

The heart and lungs, which are organs essential for life, are also protected by bony and muscular walls; and most of the great blood-vessels are well concealed.

Highly developed organs of special sense like the eye and the internal ear, are also well protected by bone. In addition, the eye is guarded by moving curtains of skin, the eyelids, which are quick to close automatically when any foreign body approaches them; and the secretions of the lachrymal, or tear glands, make a valiant endeavor to wash from the eyeball any deleterious foreign agent that may have lodged there.

The nasal cavities are supplied with fleshy cushions, richly perfused with blood which warms the inhaled air before it passes on into the lungs, and in addition the vibrissæ or hairs in the nostrils act as a kind of coarse filter and remove from the air some of the dust and germs which it contains.

The whole outer surface of the body is covered by a highly organized integument, the skin, which consists of several layers, and which performs many functions necessary for the proper continuance of life. One of its chief functions is to act as a first line of defense against the invasion of germs from without. The skin is to the body what the sea is to Britain. The best protection a surgeon or pathologist can have against blood-poisoning is a sound integument. No germ of disease can find its way through an intact

skin, but a small and invisible abrasion may throw open the portal to death. The war has increased our appreciation of this fact. In the first winter of the campaign it was found that a number of soldiers who were admitted to hospitals suffering from "trench foot," developed tetanus or "lockjaw" and died. In some cases no break in the skin was discoverable; or, at most, there may have been a small blister or a crack between the toes. Now it is the custom to administer anti-tetanus serum to all soldiers with "trench foot" in whom there is reason to believe that the skin is not intact, and, as a result, tetanus as a complication of "trench foot" has almost completely disappeared.

The mechanism by which the temperature of a normal healthy adult is kept constant, within certain well-defined limits, is also a provision for protection. The normal temperature of an adult is 98.4° Fahrenheit, and the balance is very finely adjusted. Violent muscular exercise tends to raise the temperature, and if there were no temperature-regulating or compensating system violent exercise would produce pyrexia or fever. But the stimulus of exercise increases the rapidity of the heart's action, and consequently the blood is driven more rapidly through the blood-vessels. In this way, in a given time, a larger quantity of blood passes through the capillary vessels in the skin. The skin is a great radiator of heat; the sweat-glands in the skin secrete copiously; the evaporation of the perspiration tends to cool the skin; and a cooled skin helps to keep the temperature of the blood which is circulating through it at or near the normal. In addition, there is in the brain what is known as the temperature-regulating center, which is to the temperature of the body what a "governor" is to a steam-engine. Any lesion in the imme-

diate neighborhood of this center throws it out of gear, and the temperature runs amok. When functioning properly it helps to keep the temperature at the normal.

The statement that the blood is the life is sufficiently ancient to be entitled to respect, even though physiologically it is not quite true. The blood is of prime importance to the economy, and in health it is kept at a standard which is recognized as the normal. The blood consists of two elements: one fluid — the serum — the other solid, and consisting of the blood corpuscles of various kinds. The concentration of the serum and the quantity of salt it contains is practically constant, and the balance is so delicately held that if, by artificial means, any alteration is produced it is speedily rectified by the bodily mechanism, provided that, in the meantime, the patient does not succumb.

In health the solid constituents of the blood vary within strictly narrow limits; but they have the power of adjusting themselves to new conditions. For instance, if a person who lives habitually at the sea-level is transported to the summit of a lofty mountain and lives there for some time, certain changes occur in his blood which enable him to adapt himself to his new surroundings.

On a mountain-top the atmosphere is more rarefied than at the sea-level, and consequently it is necessary to breathe more rapidly to obtain the same amount of oxygen in a given time. The oxygen is conveyed from the lungs through the central and peripheral circulation by the red blood-corpuscles or erythrocytes, each of which acts as a sort of cargo-boat, taking up in the lungs a load of oxygen, conveying it through the body, unloading it where it is required, and bringing back to the lungs a freight of carbonic-acid-gas, one of the

by-products of the activities of life. The whole process is a beautiful and fascinating piece of physiological adjustment. If we examine with the microscope a drop of blood taken from a healthy person living at sea-level, we shall find that each cubic millimeter of blood contains approximately five million red corpuscles. If, after he has resided for several days on a mountain-top we again examine his blood, we shall find that there has been a striking increase in the number of red cells. A moment's thought will give a clew to the reason for this adjustment. The oxygen of the air has to be conveyed rapidly from the lungs to those parts of the body which are crying for it. As, at each inspiration, the mountain-dweller can obtain only a proportion of the oxygen accessible to the dweller at sea-level it is necessary that the transport of the precious cargo from the lungs to the other organs and the periphery should be hastened, and the method adopted in the human economy to secure this end is to increase the number of cargo-boats. When the temporary mountain-dweller returns to the plains his superfluous cargo-boats, of which he has no longer any need, are scrapped in the ship-breaking yards of the liver.

Again, when a person or animal is bled, a very large number of blood-corpuscles are, naturally, lost. The economy would suffer and suffer seriously if provision had not been made to deal with such a contingency. Special glands in the body known as the blood-forming glands and the red bone-marrow, are thrown into activity. They elaborate new red cells rapidly, and it is possible, by examining the blood from day to day, to estimate the rate at which the damage is being repaired, until the normal is once again reached. If the same person or animal is bled on repeated occasions,

and the blood is examined with the microscope at regular intervals, it will be found that there is a considerable speeding-up in the rate at which the loss of red cells is made good. We find an interesting parallel in our efforts to combat the submarine menace which has produced such havoc among our merchant fleet. At first we repaired our losses slowly; now there is a great speeding-up in our shipbuilding yards, and loss and replacement are rapidly being brought into a condition of balance.

These phenomena, and many others which might be instanced, serve to show how carefully the bodily economy has been adjusted to cope with conditions that might be deleterious to it, and that possibly would extinguish the little spark of life that animates the whole.

Confirmed supporters of the evolutionary hypothesis used to point to certain structures in the human body which they regarded as functionless remnants of organs that had subserved important functions in animals below the human level, but which in the human being were nothing more than vestiges, useless except in so far as they indicated the road by which man had climbed in his struggle upward to the top of the evolutionary tree.

Haeckel laid great stress on the presence in the human body of these so-called vestigial parts. He said: "They are some of the weightiest proofs of the truth of the mechanical conception and the strongest disproofs of the teleological view. If, as the latter demands, man or any other organism had been designed and fitted for his life-purposes from the start and brought into being by a creative act, the existence of these rudimentary organs would be an insoluble enigma; it would be impossible to understand why the Creator had put this useless burden on his creatures

to walk a path that is in itself by no means easy. But the theory of evolution gives the simplest possible explanation of them. It says: The rudimentary organs are parts of the body that have fallen into disuse in the course of centuries; they had definite functions in our animal ancestors, but have lost their physiological significance. On account of fresh adaptations they have become superfluous, but are transmitted from generation to generation by heredity, and gradually atrophy." [1]

In making such a sweeping generalization Haeckel stumbled into the pit that lies in the way of all "scientific" partisans, who are tempted to regard the sum-total of knowledge accessible at the time they commit themselves as the whole truth. If he were alive to-day he would be compelled to modify much and retract a great deal of what he wrote as to vestigial organs, or be laughed out of court. Since he wrote the chapter from which the above quotation is taken, some of the organs which he instances there as being nothing more than vestigial encumbrances have been found to discharge functions of the highest importance in the human economy. He would be a rash man who to-day would venture to assert that any organ in the human body, however vestigial it may seem, is of no use.

In the abdominal cavity, hung like an apron in front of the intestinal coils, is a structure known as the great omentum. Haeckel did not include it in his list of vestigial remnants; but others have regarded it as a functionless structure. It consists of layers of fat, and of several layers of peritoneum — the delicate serous membrane which is to the contents of the abdominal cavity what the pleural membrane is to the lungs.

For very many years the function of the omentum

[1] *The Evolution of Man,* by Ernst Haeckel, vol. ii. chap. xxx.

was quite unknown to physiologists and to surgeons; but within the last decade it has been discovered that this unimportant-looking structure, which is in some people very rudimentary and might be regarded solely as a vestige, can and does perform services of great importance in the protection of the life of the individual. It has been taken out of the list of functionless structures, and has attained the dignity of a sobriquet all its own — an American surgeon having honored it with the title of " The policeman of the peritoneal cavity." Before the Listerian era major operations on abdominal organs were attended by grave risk for the patient. Since the introduction of antiseptics into surgical practice, and to a much greater degree since the aseptic technic grew out of the antiseptic method, the surgeon has ceased to regard the abdominal cavity as a sphere of operation beyond his reach. As the frequency and scope of abdominal operations have increased the functions of the omentum have gradually come to light.

Inflammatory mischief affecting any organ in the abdominal cavity may rapidly proceed to a fatal issue if it can break through into the general peritoneal cavity and set up peritonitis or inflammation there.

Whenever this dread complication threatens, the omentum endeavors to avert it. If an inflamed appendix is threatening to perforate, or an ulcer of the stomach is tending to break through the stomach-wall, and so flood the peritoneal cavity with dangerous micro-organisms, it is found that the omentum endeavors, in a fashion that almost suggests intelligence, to ward off this catastrophe. It orientates itself towards the inflamed part; it may actually succeed in applying itself to it, and attaching itself to the weak and inflamed part with a kind of natural glue. It thus acts as a

buttress, and lends support to the weakened part at the critical moment; and if it is not able to prevent the mischief breaking through the wall of the organ in which it has begun, it spreads itself out, and, as far as it can, shuts out the morbific matter from areas where it might exert a more baneful influence. It acts like a policeman who hears burglars in a house. He approaches the house, and sets a guard over it lest the burglars should escape; and, if they break out, he tries to surround them and hem them in lest they be guilty of further mischief, and do robbery with violence on the highway.

Far from being a vestigial remnant with no function, the omentum is now regarded as the abdominal surgeon's best friend; an assistant upon whose coöperation he can almost invariably depend.

The late Professor Elie Metchnikoff has great claims to the respect and honor of mankind, for he enriched our knowledge by many valuable discoveries. But probably the work by which he will be remembered when most of his other discoveries have been forgotten, or attributed to other men, is his long and illuminating series of observations on Phagocytosis. From a study of comparative anatomy, he observed that certain cells throughout the animal kingdom have the power of ingesting or devouring other cells or small foreign bodies, and, after ingesting them, in many cases they destroy them. He extended his investigations to the conditions met with in disease, and he discovered that the successful resistance of an animal to a bacterial infection was in large measure brought about through the activity of certain cells which he called phagocytes.

Most of the phagocytic cells are blood-cells; but Metchnikoff discovered that other cells of the body,

such as the lining cells of blood-vessels or organs, and connective tissue-cells, frequently aid in the process.

When a micro-organism finds its way through the skin into the subjacent tissues it tends to multiply rapidly if the conditions are at all favorable. It is like an enemy soldier who has broken into a valuable position. If he cannot be dealt with he becomes the precursor of a multitude. Let us imagine that the micro-organism finds the new conditions favorable to its growth. It begins to increase in number, and in doing so sets up a local disturbance. But before long the protective mechanism of the body comes into play. The precise channels through which the alarm is passed on to the controlling centers of the body have not been accurately determined; but probably it is through the nervous system that the counter-attack is planned. The essential point, however, is that volition on the part of the individual has nothing whatever to do with the extraordinary series of phenomena which follows. The blood-vessels in the immediate neighborhood of the affected part dilate, and the blood pours along them rapidly. It is this which causes a poisoned finger to throb. Then the blood-stream in the dilated vessel slows down, and from among the blood-corpuscles those known as the leucocytes, or white cells, begin to separate themselves and flow slowly along the inner wall of the blood-vessels at the margin of the blood-stream. If the germs break through the vessel-wall and find their way into the blood-stream, they are immediately attacked by the leucocytes, which surround them, endeavor to engorge them, and, having engorged them, destroy them by digesting them.

If, however, the germs do not find their way into the blood-stream, but remain outside in the adjacent tissues, the leucocytes, not to be balked by their prey, will

insinuate themselves through the blood-vessel wall and attack them where they lie.

They put into practice the doctrine that attack is the surest method of defense. A leucocyte, on battle intent, will push out a little prolongation from its body, insert this between the cells that form the wall of the blood-vessel, and gradually work its way through without leaving any discoverable aperture, and proceed to attack the germs in the open. Leucocyte after leucocyte will perform this feat, which is known as diapedesis, and hurry to the fray to wage a mighty battle with the enemy. If the leucocytes are overcome by the invading organisms a very serious illness, which may prove fatal to the patient whose body has become a battle-ground for enemy and defenders, may ensue. If the battle is localized and the invading enemy is defeated, an abscess may result. If its contents are evacuated by the knife of the surgeon, and examined with a microscope, they will be found to consist of dead leucocytes containing in their substance the organisms they had succeeded in killing before they were themselves overpowered; micro-organisms living and dead, and broken-down tissue cells, the débris of houses and homes, shattered as in the brave land of France by the intensity of the conflict that has been waged in their midst.

This account is no fairy tale of science, but solid fact which has been verified over and over again.

Cast into a more picturesque narrative, which will easily be remembered, we may present the above facts in this way. Just as every country with a large merchant fleet requires to maintain a navy for its protection, the body, which has many cargo-boats (the red blood-corpuscles), has also a battle-fleet — the white blood-corpuscles, or leucocytes. Of these there are no

less than 7,500 in every cubic millimeter of blood. When war breaks out the navy is mobilized, and there is a concentration of vessels of war at the place where they may best deal with the enemy. They endeavor to blockade him; and, if he will not come out into the open sea — the channels of the circulation — they will attack him, if possible, in his lairs; just as our navy has sought to destroy by bombarding or by bombing from naval hydroplanes the haunts of the submarine along the Belgian coast. During a war there is, of necessity, great activity in all our naval yards in order that the fleet may be increased. Old cruisers are taken out of the yards and sent to sea again, and the building of new ones is speeded up. In the same way there is an enormous increase in the number of white corpuscles met with in the circulating blood. Leucocytes that had been resting are poured into the circulation, and new ones are produced in the blood-forming glands and hurried into the circulation to take part in the conflict. The call for help may come from the remotest part of the Empire: from the Falkland Islands (or from the tip of a poisoned finger): but wherever it comes from, the Navy, or the leucocytes, are ever ready to seek the enemy out and give him battle wherever he may be found.

The activity of the leucocytes and their capacity for waging war successfully upon the invading enemy vary in different individuals, and in the same individual at different times. This is one of the reasons why a poisoned wound in one person may have much more serious consequences than in another.

Not every fleet that sails the seas is ready at any moment to give battle to the foe; but the country whose navy is always prepared, or the individual whose white blood-corpuscles are always in fighting trim is little

likely to succumb to a sudden attack of the enemy. A navy that is kept in fighting condition by frequent maneuvers and by constant gun-practice is likely to give a better account of itself when the hour comes than one which never has the opportunity of testing its own capacity. It has been ascertained by experiment that the phagocytic properties of the leucocytes may be greatly increased by artificial means. Sir Almroth Wright has made many valuable deductions from this observation, and vaccine therapy, of which he is the foster-father, is a practical application springing from it. If a quantity of dead micro-organisms of any kind be injected under the skin of a patient it is found that, in a few days, his leucocytes have developed the power of engorging, on an average, more micro-organisms of that particular variety than they had before. Their phagocytic power has been increased, not toward all organisms, but for germs of that special kind. If, therefore, a vaccine be made from the bacteria found in a boil and injected into a patient suffering from that painful affection it is found that not only do the phagocytes seize on and devour the dead organisms in the vaccine, but, like Oliver Twist, they ask for more, and attack with avidity the germs responsible for the patient's condition.

Vaccine therapy is still in its early youth; but it has secured undying laurels in the present war, for, largely owing to its application, the incidence of typhoid fever, which in all previous campaigns was a pestilence to be dreaded, has been reduced almost to the vanishing point.

But the body has other protective mechanisms besides phagocytosis, which are called into play when the need arises. It is a well-established fact that some animals and individuals are much less susceptible to certain diseases than others. It is also well-known

that an attack of a disease such as small-pox or scarlet fever will protect a person against another attack for a considerable number of years or for a life-time.

Once it was believed that an infectious disease used up some pabulum or food which it found in the patient's system; and, as it was supposed to destroy this pabulum, there was none left for a second attack of the disease to feed on. But now it is recognized that this idea was erroneous, and that, whatever substances a disease may destroy in our blood, it enriches the blood by causing the prophylactic mechanisms of the body to elaborate protective agents.

When a micro-organism invades the human body, *pari passu* with the production of poisons or toxins whose effect may be lethal, there are produced substances that are inimical to the growth of the germ. A well-known parallel to this is met with in the case of the yeast fungus. If this organism is grown in a solution of sugar it vegetates luxuriantly, and converts part of the sugar into alcohol. This is a poison for young cell-life, and when the alcohol reaches a certain degree of concentration the yeast fungus is destroyed by it.

If a person become infected with pneumonia we have a striking example of how the protective mechanism in the body operates. Pneumonia is an acute inflammation of the lungs, and it is now known to be due to a micro-organism. The germ invades the lungs, and begins to multiply there. The earliest symptom of which the patient is conscious is usually a sensation of chilliness, followed by violent shivering. This is the first manifestation of the protective mechanism in action. The sensation of chilliness is due to a contraction of the blood-vessels in the skin whereby as much blood as possible, and therefore all the available leucocytes, may

be hurried to the invaded part. The violent shivering, which is due to rapid and repeated contractions of muscle fibers throughout the body, is involuntary, but purposeful and protective, for active muscular exercise is the speediest means of increasing bodily heat. A temperature of 102° F., and over, is inimical to the growth of micro-organisms, and the patient's temperature is rapidly elevated above that degree as the first step in the protective scheme. As the organisms grow they produce poisons or toxins which are thrown into the circulation, and which may have a deleterious effect on the muscle-fibers of the heart, and the nerve-ganglia which control its action. The heart already has a sufficient mechanical strain thrown upon it, as it requires extra power to maintain the circulation in a lung which is rapidly undergoing consolidation. But the protective functions of the body are at work, and are rapidly producing substances which are antagonistic to the toxins, and to the micro-organisms which are the cause of the disease. These substances are known as anti-toxins, and they unite chemically with the poisonous products of the organismal growth, and render them inert to the living tissues. What part of the anti-toxin is not required to neutralize the toxin remains over to exert its effect on the germs — an effect prejudicial to their further development, and therefore beneficial for the patient. The occurrence of what is known as the " crisis " in pneumonia, when the temperature rapidly falls, the rapidity of the heart-beats and the respiratory rate come down to something like normal, and the patient in the course of a few hours undergoes a marked change for the better, indicates the point at which the amount of anti-toxin elaborated in the body exceeds the amount of toxin, and so can neutralize it.

In pneumonia we are therefore the witnesses of a race between the production of toxin and anti-toxin; and if the heart can hold out while the contest is at its hottest, a point will be reached when the anti-toxin will overpass the toxin, and the patient will recover. Observations of this kind and practical deductions made from them have opened up an immense field for curative endeavor.

It has long been known that the animal economy could accustom itself to small repeated doses of certain poisons, until a stage of tolerance is reached at which an enormous amount of these poisons may be administered without much effect. Every smoker has more or less poignant memories of his first pipe. Tobacco is a poison, and for the neophyte a first small indulgence often produces uncomfortable results. But, if he try again, his system gradually becomes accustomed to the poison, so that a smoker of some years' experience can consume in the space of a few hours an amount of tobacco which might kill a boy were he to indulge in the same quantity on the day of his first surreptitious pipe. A like truth holds good with regard to alcohol, and De Quincey affords a classical example of the tolerance which the human system may develop towards opium. Abrin and ricin are two highly poisonous vegetable substances; but Ehrlich found that by small successive doses of these substances a condition of tolerance towards them could be established among animals. Armed with this knowledge, he carried his experiments a step further. He fed mice on abrin and ricin, and, when they had developed a high degree of resistance to the poisons so that they were able to consume without prejudicial effects a much larger dose than that which, originally, would have killed them, he drew blood from them and injected the

fluid part of the blood into other mice. At the same time he administered to this second group of mice large doses of the vegetable poisons, and he made the important discovery that a mouse treated with serum from an animal highly immunized against abrin and ricin by progressive feeding was able to consume no less than forty times as much of the original poison without disaster as it could do before it was treated in this way.

The practical applications of this experiment have been far-reaching, and the ultimate goal is not yet in sight. One of the most fruitful developments issuing from this observation was the preparation of diphtheria anti-toxin. Roux and Yersin made a careful study of the toxins of diphtheria, and their work, supplemented by that of Behring, resulted in the discovery of a new and highly successful treatment for that dread disease.

If small and repeated doses of diphtheria toxin, procured from the cultivation of the *bacillus diphtheriæ* in a suitable broth, are injected into a horse it is found that the horse is not rendered ill thereby, but there is gradually produced in its blood an enormous quantity of a substance that can not only kill the diphtheria germ, but also neutralize the diphtheria toxin. This is diphtheritic anti-toxin; and the modern treatment of diphtheria consists in injecting under the skin of the affected person, as soon as the diagnosis is made, a large quantity of serum drawn from a horse which has been rendered immune, in the manner described, towards the bacilli and toxins of diphtheria. In a case of diphtheria which recovers without the administration of anti-toxin the patient has had to rely on the efforts of his own protective mechanism for the elaboration of this substance, and there has been a heated

race between the production of toxin and anti-toxin. To administer anti-toxin in the earliest stages of the disease is to confer upon the patient a very great advantage, for he thus enters the race with an enormous quantity of ready prepared, highly potent anti-serum with which to neutralize the poison that the germ will produce as it grows in his throat. Thanks to Behring and Roux, the word "diphtheria," which at one time was pregnant of ill omen and bore a particularly sinister meaning for all parents of young children and for all physicians who devoted themselves specially to work among children, has lost much of its dread significance.

All modern treatment founded on the administration of vaccines, anti-toxins and anti-sera has been built up from the recognition of the protective mechanism existing latent in the body. There is little doubt that all dwellers in cities are daily being immunized against various diseases by the continual ingestion or inhalation of disease germs. Where the initial dose is too large, or the resistance of the individual too low, a serious illness with, possibly, a fatal issue may result.

Civilization and acquired tolerance of the germs of disease proceed hand in hand. On a virgin soil, such as the New Hebrides, an epidemic of measles may rage like a plague and destroy a large portion of the population. We and our children are daily breathing or swallowing morbid germs in small quantities, and these stimulate our protective mechanism so that one day when we engorge a larger quantity of germs than usual our immunized constitutions are able to repel the assault.

Those who find in physics and chemistry an explanation of all the phenomena of life are ready to explain all these facts in terms of their two pet sciences, and

they have invented a terminology to designate every stage and event in the phenomena of protection. They are satisfied with secondary causes; they regard any first cause as unknowable. However that may be, there is surely ground for the belief that such beautiful and coördinated devices as we have indicated, coming into play for the protection of life must have had their origin in no haphazard chance, but in a great and intelligent Mind.

CHAPTER VI

HEREDITY AND ENVIRONMENT

"La petite cellule initiale d'où dérive chaque être vivant et qui, développée dans un sens déterminé, deviendra oiseau, homme ou chêne, contient un long passé et un immense avenir. Ce minuscule élément chargé d'un entassement de siècles révèle un monde de forces, orienté par un mecanisme dont la compréhension reste très au-dessus de notre intelligence."

Dr. Gustave le Bon. *Hier et Demain.*

We have seen how the life of the individual is protected by delicate and complex mechanisms of defense. The power of reproduction, which is given to the individual, and the principles which underlie heredity, are the chief agents for protecting the life of the species.

That like begets like is a fact of common knowledge, but why it should be so is an unfathomable mystery. Among the bacteria and the protozoa, where multiplication takes place by a simple process of division, there is nothing strange or puzzling. But in the higher realms of nature, where reproduction is complicated by the antecedent necessity of a union between the male and female primordial elements, the problem widens and becomes more and more obscure.

If we take the fertilized eggs of a fly, a frog, and a fish we may be able to distinguish between them by their shape and size; but, so far as test-tube and microscope can tell us, the protoplasm of which they consist is identical. And yet, even if they are allowed to develop in the same pond under conditions that, as far as possible, are identical, they will ultimately become fly,

frog, and fish, separated from each other by the whole diameter of genus. Nor is this all. Like begets like with extraordinary faithfulness. A child resembles closely one of its parents, or both. In build and general appearance, shape of features and limbs, color of eyes and hair, texture of skin, disposition, and other mental qualities every child is a pocket-edition of its parents. But it is more than that. It exhibits qualities or features that have come to it from ancestors more remote, so that Emerson was justified in saying: "Every man is a quotation from all his ancestors."

With quaint fancy Robert Louis Stevenson [1] enlarged on this idea when he wrote: "Our conscious years are but a moment in the history of the elements that build us. . . . And though to-day I am only a man of letters, either tradition errs or I was present when there landed at St. Andrews a French barber-surgeon to tend the health and the beard of the great Cardinal Beaton; I have shaken a spear in the Debateable Land and shouted the slogan of the Elliots; I was present when a skipper, plying from Dundee, smuggled Jacobites to France after the '15. . . . Yes, parts of me have seen life, and met adventures, and sometimes met them well. And, away in the still cloudier past, the threads that make me up can be traced by fancy into the bosoms of thousands and millions of ascendants: Picts who rallied round Macbeth and the old (and highly preferable) system of descent by females, fliers from before the legions of Agricola, marchers in Pannonian morasses, star-gazers on Chaldean plateaus."

It is not my intention to encumber these pages with the fascinating details of embryological development which have been studied so carefully, and mapped out

[1] *Memories and Portraits: The Manse.*

with such minuteness that they are now as plain as a mariner's chart. But, though this gigantic work has been accomplished with infinite labor, we are still entangled in mystery, for we cannot discover whence it comes that in the infinitely small speck of protoplasm which is the arena of all these changes such potentialities of growth and change, such undeviating loyalty to the traditions of the species are already inherent.

Long ago, before anything was known of the mechanical changes attending embryological development — for we had to wait for the microscope to reveal them — various shrewd guesses were made to explain the mysteries of heredity. But none of them appeared to satisfy the facts so adequately as the theory of *pangenesis* enunciated by Charles Darwin. According to Darwin, every part of the body and every organ in the body of an individual gives off tiny buds, or " pangenes," which are conveyed by the blood to the organs of reproduction. Each germinal cell, both of the male and female, in this way becomes possessed of a complete set of these buds, representing not only every organ, but every cell in every organ, every cell in every bone, and every cell in the skin, and all its appendages, such as the hair and nails. In the process of development, on this theory, there is simply a progressive unfolding and growth of all these pangenes enclosed in the male and female primordial germs, and, consequently, the offspring resembles its parents.

This theory was a brilliant one, but it lacked probability, and the practical difficulties associated with it seemed insuperable. For instance, a cod-fish can lay some 9,000,000 eggs in a season, and if every cell in the fish's body were to be represented by a pangene in each of the 9,000,000 eggs, the whole bodily activity of the fish would be occupied in the budding off and trans-

port through the blood of this incalculable number of pangenes. Darwin himself, one of the clearest thinkers of his own or any other age, saw the difficulties that beset his theory, to which he had been driven in his endeavor to account for the transmission of acquired characters, such as modifications in bodily structure produced by disease, by mutilations, accidental or due to operative interference, or through the use or disuse of special organs. In Darwin's time a belief in the transmission of such acquired characters was generally accepted, but now it is only adhered to by a small number of biologists.

The theory of heredity which receives the greatest support to-day is that put forward by Weismann. It is a theory that may be said to be pragmatic; it serves, and enables us to understand, in a reasonable way, some of the facts of heredity. The essential principle of the theory has been expressed as "the continuity of the germ-plasm." By this is meant that a certain part of the germ-plasm, or primordial protoplasmic material contained in the parent egg, is not used up in the structural elaboration of the body of the new embryo, but is set aside, and kept for the formation of the germ-cells of the new generation. In confirmation of the soundness of this theory it may be mentioned that, in several cases, the setting apart of the germ-plasm has been observed with the microscope at the commencement of the development of a new embryo. Thus the germ-cells are said to pass on in the direct line from generation to generation, while in each generation the cells which go to form the body and the organs it contains are simply off-shoots from the germ-cells. The body is a kind of protecting covering thrown out to ensure protection for, and to acquire the nourishment needed by, the germ-plasm. On a theory such as this

we begin to understand how it is that like begets like, and why children resemble their parents or immediate ancestors more than they resemble the children of other people. It gives us a groundwork of understanding whereby we may comprehend why A.'s children resemble A. rather than B. For the germ-plasm from which they have originated has passed down to A. thrcugh many generations, and is continued in his children for transmission to the next. It is the old poetical idea of the torch of life — *lampada vitae* — translated into a physiological fact. This theory of the continuity of the germ-plasm enables us, further, to understand why it is that acquired characters — that is, characters that have been assumed during the life-time of the individual — are not handed on. An "acquired character," as that phrase is or ought to be understood, means a change in the *body* of the individual or organism under consideration, and not, except secondarily, in its germ-plasm. As the germ-plasm remains unchanged throughout any modification in bodily structure acquired during the life of the individual, the modification is not transmitted.

At various times and from various sources instances have been derived which would appear to suggest that acquired characters are transmitted. But we must guard against accepting a principle from an isolated handful of instances. There is, certainly, ground for the presumption that acquired characters may be passed on: but, on the other hand, exact experiments carried out with a view to ascertain the truth have yielded at most results that were inconclusive. There is the fundamental difficulty of conceiving any mechanism by which such variations could be transmitted; but that difficulty is no greater than others which confront us in any attempt to study the mysteries of life,

and, to be fair, we are not entitled to rule out the possibility because our knowledge, as yet very imperfect, has not given us a clew as to how this might be possible. There may be a process or mechanism that we know nothing of. The biologists are divided in their opinions on the matter. At present the verdict is, "Not proven." It would be in the highest degree unscientific to say dogmatically that such hereditary transmission is impossible and never occurs. Many of us may live to see the results of a great natural experiment which is at present in operation. At the present moment a large proportion of our young men are suffering from "acquired" characters — the result of wounds. Many of them have lost a limb. These mutilations will not prevent them from marrying and becoming the fathers of children. It is, however, in the highest degree unlikely that any of their children will be born structurally defective — lacking an arm, or a foot, an eye or an ear, because their father had lost one or other of these parts in battle. Life is too jealous of her own perfection to suffer that.

The most recent contribution of value to the study of heredity is that made by Mendel. A little more than half a century ago Gregor Mendel, a Silesian monk, was quietly carrying out observations and experiments on the crossing of common peas. He classified his results with care, and made certain important deductions from them; but, strange to say, when he published a paper detailing his experiments and embodying his conclusions, it received no public scientific welcome, but was allowed to lie buried in the archives of the society to which he had communicated it, for thirty-five years. It was not until the law which Mendel had discovered by his patient researches was rediscovered in 1900 by three separate botanical inves-

tigators that the neglected paper of the forgotten monk was dug out of its grave, and his title to the name of a great scientific investigator established. Correns, Tschermak, and De Vries were the first to confirm Mendel's law; and his observations and conclusions have been substantiated and received further demonstration from the work of Punnet, Bateson, and Drinkwater.

It is outside the scope of this chapter to describe in detail the experiments upon which the doctrines of Mendelism are founded. Those who are interested may pursue the study further in one or other of the monographs which are devoted to the subject. Mendel's great contribution to the science of heredity is that he proved that the transmission of certain factors from one generation to another is no haphazard occurrence, but is definitely controlled by laws which may be reduced to mathematical formulæ. He ascertained two great facts, and established two great principles. He showed that in the first hybrid generation there manifests itself, at the first crossing, a complete triumph of the characteristics of one parent, the characteristics of the second parent being suppressed. This he called " dominance." In the second generation he pointed out that what he called " segregation " occurs. By this he meant the appearance in definite proportions in the second generation of the characters which were combined in the cross.

His experiments have been studied, verified, imitated, and extended, and the following are some of the conclusions which have been gathered from the accumulated facts. It is now believed that in any living organism there are certain qualities or characteristics that are capable of varying independently, and which may depend on some quality or factor in the germ-

plasm, and are therefore transmissible. They can be separated out, identified, and followed through a series of breeding experiments. They are called " unit " characters, and the principles which govern their appearance are known as " unit " factors. Complete heredity from one parent to his offspring would mean the handing on of the sum-total of these " unit " factors. No character reveals itself in an individual unless the corresponding factor has been handed down to it. Factors may be handed on and remain undeveloped; but they may suddenly thrust themselves into prominence in a subsequent generation. This explains why a characteristic belonging to one or other of its grandparents may appear in a child whose parents lack this quality. Mendelism is not difficult to understand when it is applied to the crossing of pea-plants. But its problems become infinitely more complex when the facts of human heredity are closely studied. Many disturbing factors come into play, so that, except for special features, such as the color of the eyes, the color of the hair, the shape of the hands, and other more or less minor details, Mendelism as applied to man has so far had only minor successes. Human heredity is a much too complex thing to be capable of reduction, as yet, to mathematical formulæ. Heredity, with all that it connotes, still remains a profound mystery, and is, I believe, inexplicable unless we are prepared to admit some mysterious controlling and guiding principle which science has so far failed to recognize.

Important as the heredity which has stamped its hallmark upon an organism or an individual may be, there is another factor constantly at work in molding it, namely, its environment. The finished article, be it vegetable-marrow or man, is the resultant in a parallelogram of forces, the factors of which are heredity, or

what it brings with it into the world, and environment, or the play of world forces upon it. So far as it concerns the individual, heredity stops at his birth, though the burden or the treasure it may have bound upon his shoulders is sometimes not revealed till after a long period of years. Its greatest influence is antenatal. The environment of the parents may affect the heredity of the child for good or ill; but the major part of the effect of environment is a post-natal and personal matter.

A leek or a lily grown in the open air has green leaves, but if the plant is forced to live in a dark cellar where the sunlight cannot reach it, its leaves are white. It requires the energic touch of the sun to enable it to elaborate the green chlorophyll, which gives it its verdure. Or it may be grown in the sunlight, in soil from which all traces of iron have been removed, and its leaves will remain pale. But if a little iron be added to the soil the leaves will quickly assume their natural hue. Here we are dealing with only one factor in the environment; but in nature, as a rule, the circumstances are more complex.

The response to the conditions of environment are well shown by the behavior of certain Alpine plants. If taken from their natural habitat and cultivated in the lowlands, they undergo material alterations in character. They grow to a greater height and their leaves expand in length and breadth. So long as the plant remains in the lowlands it will exhibit in each successive generation these altered characters. But if one of the plants is transferred once more to its original habitat, high up upon the bleak mountains, it will once more assume the Alpine characteristics, which continue to persist so long as the plant or its descendants live under the same conditions.

E. S. Goodrich [1] quotes an interesting example of the effect of environment.

A French botanist, Bonnier, divided a common dandelion plant and grew one half in the lowlands and the other at a considerable altitude among the mountains. The part grown in the lowlands developed into a tall and slender plant, while the part transferred to the heights underwent very considerable modifications. It developed longer roots, probably in order to derive adequate nourishment from the sparser soil; its stems were shorter and its leaves smaller, probably because its nourishment was deficient; its leaves were more abundantly supplied with hairs, and its flowers were larger and brighter. No doubt this latter modification was with a view to attract insects, to ensure its propagation. The seeds of the Alpine plant, transferred to the lowlands, reproduced the lowland form. If planted in the mountains, the Alpine type was reproduced; and seeds of the lowland form cultivated among the heights developed into the Alpine type; while, if either form were transplanted bodily to the habitat of the other, it assumed the type common to its new surroundings. Goodrich concludes: "This change is accomplished by the new-growing tissues, for the already formed tissues are no longer capable of altering. Once fully differentiated they are 'fixed.' So we see that organisms are molded by their environment; it is not the developed result which is transmitted, it is not the modification which is inherited, but the capacity for modifications in certain directions, the modifiability."

In the nature of things it is perhaps to be expected that the influence of environment should make itself felt

[1] *Evolution,* by E. S. Goodrich, M.A., F.R.S.

in plant life; but it plays a great part in producing modifications of animal life as well.

It has long been known that if a sea-water protozoon be transferred suddenly into fresh water it will quickly die, a victim to its unwonted environment. But if, instead of undergoing this brusque and fatal transference, it be placed successively in more and more dilute solutions of sea-water in which the concentration of salt is progressively diminished until pure fresh water is reached it will gradually acquire such powers of tolerance towards its altered environment that it will continue to live.

Similarly, if we take a protozoon which is normally found in fresh water and suddenly place it in sea-water it will at once die; but it may, like the salt-water protozoon, develop the power of living in an unaccustomed medium if, instead of a sudden transference from one extreme to another, we allow it time to accustom itself to new conditions by carrying it through a series of waters containing more and more salt until we reach sea-water. Physically the two protozoa may resemble each other so closely that it is impossible to tell from a mere inspection whether they belong to the sea-water class or the fresh-water class; but the point may be settled at once by immersing them in sea-water, when the fresh-water protozoon will immediately die.

Fish, insects, and crustacea which have lived for generations in the waters of a dark cave gradually lose their eyes, since vision is of no further use to them; but the fins, tails, antennæ, and limbs with which they are provided grow enormously in length, so that they may even exceed the length of the creature's body. These limbs, thus adapted by environment to meet the special requirements of the creatures to which they belong, enable them to recognize obstacles, to feel for

food, and to avoid collisions with each other or with the rocks and stones of their habitat. They are to those sightless creatures what his stick is to a blind man.

Any one who has ever watched a mountain spring bubbling up from between the ribs of Mother Earth has before him, if he will allow his imagination to play upon it, a picture of the whole story of heredity and environment. The water gushes up, fresh, sparkling, and cold, and incorporate with it are some qualities it has gathered from the earth. What history lies behind it we cannot tell, but we know that, long before it was cloistered in the hidden reservoir from which it is now bursting, it fell from the clouds upon the flanks of the surrounding hills and percolated gently through into some dark and undiscovered recess between the buried rocks. Long before it fell from the clouds it had been lifted up from the smiling surface of the sea, by the energy of the sun. But whether in the sea, or in the clouds, or distilling as dew or rain upon the hillside, it was water all the while: for the germ-plasm is continuous.

And now it is coming forth again into the brave light of heaven eager to run its appointed race. It tumbles down the hillside, water still, but as it goes it takes up and carries with it new qualities it has filched from its environment. Here it washes away some earth from an overhanging bank, and is made, for the moment, turbid; there it dissolves some salts from the rocks against which it frets as it moves onwards, and yonder, where it sweeps into the valley it scoops large débris from a bank of clay. In the valley, its course is stayed for a little while, and it drops into the silent depths of its stagnant pools some of the earthy débris with which it has become burdened.

Then it flows gently on, past farm and croft, broadening and deepening as it is fed by tributary streams, mirroring the overhanging trees, catching the shadows of every fleecy cloud, plowing its way by the easiest path, deflected here by a barrier of rock and there by a promontory of beaten earth that it cannot wash away. Or it enters a defile between buttresses of rock which narrow it down so that it races in a wild tumult between its precipitous banks.

It is perpetually yet never the same; and one may stand beside it in one's childhood, and after the long lapse of years again in one's old age and say, "This is Avon, or Nith, or Thames." For a stream of running water is indeed a true picture of personality — of continuity amid and in spite of perpetual change.

The sun kisses it at noon-day, and lifts up from it an armful of vapor to repair some exhausted cloud; the frosts of winter touch it with iron hand, and it is fettered with ice; but, cloud or ice, it is the same water still, the impotent creature of environment. It flows on, past hamlet and through town, and its fair beauty is sullied by contact with human kind. It has lost its pristine beauty, but it is the same water still. And so, on it goes, through the sunlight and under the star-encrusted sky, till it pours into the cleansing bosom of ocean, where all the adventitious qualities it has gathered up from its environment are lost in the immensity of the sea. It was water when it burst from the hillside; it is water when it reaches the ocean; it has preserved its identity, though its identity has been influenced over and over again by its environment. Like the germ-plasm, it has held on in an unbroken and continuous line: and environment has been able to do no more than mold its character for a little while.

Applied to human life the influences of heredity and

environment have large and broad results. Primarily it is heredity which has most to do with the physical side of a child's life; but, in so far as mind is rooted in brain, heredity plays a part in endowing the psychical side of life with certain tendencices or aptitudes, by giving the child a brain of a certain texture, with nerve-cells sluggish or active, slow to respond, to stimuli, or alert and alive. The child of healthy, vigorous parents is much more likely to start life with a good physique than the child of delicate parents. If a child comes of a long line of healthy ancestors it is much more likely to be born a splendid specimen of infant life than if it had behind it nothing better than a family tree with withered and delicate branches and an unsound stem.

With very few exceptions, diseases are not transmitted directly, at birth, from parents to children. For instance, tubercular parents, who are proverbially fertile, very frequently have fine children; but these children start life handicapped in so far as they inherit, through the continuity of the germ-plasm, a textural quality of the bodily organs which is frequently unable successfully to resist infection by the organisms of tuberculosis which we breathe daily. Tuberculosis may be actually transmitted from parent to child, but this is extremely rare. Bring the child of tubercular parents up in an unsuitable environment, expose it to the infection of tuberculosis by allowing it constantly to associate, at close quarters, in all the little intimacies of affectionate home-life, with its tubercular parent, and it is almost certain to contract the disease. Here we have an example of the effect of environment upon a child predisposed by heredity to a specific malady. But if, at a very early period of its life, that child were taken to the country, brought

up in healthy surroundings, in a house where no tubercular person has previously lived, allowed to bathe in the glories of the sunshine, and to take largesse from the clean ocean of the country air, well fed, well clad, and well cared for, it is more than likely, indeed it is practically certain, that it would through its favorable environment be able to overcome the inborn tendency with which it came into the world, and grow up to be a healthy man or woman, whose children would start the race of life without the initial handicap which weighed upon their parents.

Any one who has studied with an observant and sympathetic eye the child-life in the slums of a great city must have been touched often to sorrow, and not infrequently to anger. Many children born in the slums are magnificent samples of human babyhood. This is particularly the case in a city like Liverpool, where many of the unskilled laborers are young Irishmen who have been brought up in the country, but who, through the allurement of more work and better wages, have been attracted to the town. Some of them marry girls of their own class with a country heredity behind them, and the children born of such a union are infants of which any mother might be proud. But watch these children grow up in the body-warping, soul-destroying environment of the slums. Instead of the green fields where their father and mother scampered barefooted as children, they have the gutter for a playground; for the pure air of heaven which blew round the little thatched cottages where their parents were born, they have the exhausted, fetid, disease-laden atmosphere of a great city; for the blue expanse of the open sky, they have a few adventurous but anæmic rays of the sun, which filter with difficulty into the narrow courts where they

dwell; for the wholesome potatoes, porridge, and buttermilk of their parents' country, they have food of a dubious nutritive value packed in a tin in some trans-Atlantic slaughter-house; for the song of the birds, they have the unmelodious clatter of an Italian piano-organ; and, for the benediction of the stars, the uncertain light of the street lamps. It is therefore little wonder that the splendid start with which they began life is rapidly stolen from them by their environment, and that, from the time they are weaned, they begin to deteriorate. They become stunted, rickety, emaciated, and prematurely old. They are the victims of diseases of the eyes, the ears, the throat, the skin, the bones. They are adults before they have had any childhood, and old men and women when they ought to be in their prime. The tragedy of all great cities is the tragedy of the child-life of the slums, and I have often wondered if at an early age a large experiment in the transference of child-life were performed, and the children of the rich were transported to the slums and brought up in that environment, whether they would do half as well as the children they have displaced. Few things, if any, can be more soul-destroying and body-killing than life in the rookeries of slumdom, and I have sometimes wondered whether, if it had been my fate to be born and brought up in a slum, my soul would ever have risen above the level of a pot of beer. The marvel is that the children of the slums do so well as they succeed in doing. Not once, but many times, in the crucible of the war, where the souls of men have been tested, the boy from the slum has stood in the same line face to face with the same danger, and confronted with the same opportunity of sacrifice as the lad from the home of broad acres with the traditions of his class and school behind him.

And the lad from the slums has shown himself as brave a man, and as generous a man, with instincts of altruism as fine as his more favored brother. He has had no advantages of birth; his environment has been of the worst; but he has learned how to die like "a very gallant gentleman." For a man's soul is a big thing, and no circumstances can triumph over it.

And when the drum-fire of the heavy guns is silenced and we return to the longed-for, happy days of peace, I imagine that the understanding come to in the face of death between the favored of fortune and their humble brothers will not readily be broken. To face danger together, to bleed together, and, if need be, to die together, breaks down the artificial barrier of class; and the lad from the slums, companying with him in the inferno, has learned to trust and honor the lad from the broad acres; and the boy from the mansion has learned to understand and respect the boy from the city court. In so far as they were artificial, the war has smashed up class distinctions, and what Burns long ago tried to teach has to-day a wider acceptation:

> "The rank is but the guinea's stamp,
> The man's the gowd, for a' that."

Environment, though it may neutralize much of the good with which a child is endowed by heredity, may act in the other direction, and exert a beneficial effect upon a child which has started life handicapped by a bad ancestral taint. Good food and warm clothing, which are physical conditions of life, and wise education and careful discipline, which are mental conditions of life, may convert a poor, wretched child of the gutter into a respectable man or woman. Barnardo's Homes in England, Quarrier's Homes in Scot-

land, and every industrial school and training-ship in the country, are standing witnesses to the saving grace of propitious environment.

Environment in nature, with all that it connotes, is one of the regulating factors which helps to ensure the survival of the fittest. But in human life so much of our environment is artificial that it kills many who, by heredity, were well fitted to survive, and protects and shields others who, in virtue of their physical handicap at birth, would have little chance of surviving were they not specially nurtured and surrounded with all the comforts that wealth and devotion can procure. Nature is ever seeking to improve life, but sometimes man steps in and interferes to protect the weakling which would otherwise succumb. But in the long run Nature wins the day, for ultimately a weakly family dies out: or the weakness, if it be due to a transmissible disease such as syphilis, ceases to be operative after a generation or two. Though people of unsound mind may beget children, they are often sterile; and if they do become parents the family either tends to become extinct or the mental weakness to be eradicated.

Fortunately, also, the chronic alcoholic is often childless, for Nature is jealous of the purity of her stock.

Where the laws of Nature are allowed to operate freely the results tend to maintain a satisfactory equilibrium. But man can and does upset the balance occasionally.

Science, with groping finger and inquiring eye, has discovered for us some of the secrets that lie behind heredity and the influence of environment; but we have been very slow to apply them. Most often the application of a principle precedes the discovery of the scientific facts upon which it depends. The richness

of Tyrian purple was admired and used before the science of chemistry had cracked its shell, and men made melody before there was any science of acoustics or laws of harmony; but in this great sphere where the application of principles, established by science, might have done so much, practically nothing has been attempted except in so far as animals are concerned. The breed of horses, of dogs, of cows, and of sheep has been improved for the sake of paltry prizes on the race-course, or at the cattle-show, or for the enrichment of a few enlightened agriculturists; but, so far as the human race is concerned, practically nothing has been done on any large scale either to improve the breed or to protect it from the deleterious effects of a bad environment. To think of the matter seriously is to be staggered by our own ineptitude. Man, who has discovered whatever is known about heredity and environment, is the last to profit by his knowledge.

If we are to recover in a reasonable time from the desolating havoc which the carnage of war has brought among the flower of our manhood we must set about applying our knowledge at once. Any effective scheme will entail a vast expenditure, but a country that can pour out close on £7,000,000 a day for the protection of its frontiers, and, incidentally, for the destruction of the lives of its enemies, should be able and willing to spend lavishly of its substance in protecting and saving the lives of its own people. The expenditure of a sum equal to our share of the cost of the war for one month would be sufficient, I imagine, to tear down and rebuild, as wholesome dwelling-places, practically all the slums in the country. And if this estimate is too low — for I am only a physician and no financial expert — surely the result could be obtained by devoting to this end a sum equal to one week's war expenditure every

year for ten or twenty years. Hitherto we have reared an Imperial race in slums; but it is our bounden duty to see that we make the Britain our men have bled and died for a country worthy of their great sacrifice, where life can be lived under wholesome and healthy conditions. To abolish the slums would be to lessen enormously the incidence of disease. Many infectious diseases find hot-beds for their propagation in the slums, and the mischief spreads from the rookeries where it has developed to the better-class dwelling-houses: for thus are we punished for the neglect of our poorer brethren within our gates. Better housing conditions, more space, more light, more air, would speedily reduce infantile mortality. And if, side by side with a sane policy of housing reform, we had temperance reform as well, and such economic reforms as would abolish sweating — that inhuman system whereby the vampire middleman grows fat on the blood and tears of women and little children — we should have done much to improve the environment of the young life of our country, and given it a chance to grow and develop as God meant it to do. And, side by side with these reforms, we require educational reform. More attention should be paid in schools to instruction in the elements of hygiene, and all senior girls should receive lessons in mother-craft. No scientist would hand over to an uninstructed girl a delicate piece of scientific apparatus, and expect her, by some natural gift of intuition, to know how to handle it, control it, and use it. But, by habit, that is what we are daily allowing to occur. Girls of all classes marry without the haziest ideas as to child-nurture and child-welfare. It is therefore little to be wondered at that the proportion of babies which die in the first year of life is enormously high, especially in our great cities. A

considerable number of these unfortunate infants are first babies. They die that through their unavailing tears their inexperienced mothers may acquire some slight knowledge of how to rear children. They are vicarious sufferers, sacrificed that the conditions of life may be more tolerable and less lethal for the brothers and sisters who may follow them. But what a wastage! In these late days, and in spite of our civilization we out-Herod Herod.

Surely there is a better way of teaching mother-craft than in such a stern and spendthrift school, and, in an age when such stress is laid upon the rights of the community, let us not forget that the individual has rights, even though it is only a slum-baby who has "no language but a cry." Every child born into the world, legitimate or illegitimate, has the right to live. The law recognizes this by laying punitive hands upon any one who by violence robs the youngest infant of life. But a thousand times more children are done to death through ignorance than by homicidal violence, and the law, or the law-makers, stand by and do nothing.

In paying due deference to the rights of the individual we are sometimes in danger of forgetting the rights of the race, which are infinitely greater. Hitherto human mating has been too much a haphazard matter. Love is not always wise. But a time is coming when no man or woman will be permitted to marry unless they can produce a certificate of health. The requirements need not be pitched too high; but they should consist of at least moderately good physique, soundness of mind, and freedom from any disease capable of being transmitted to the children, or, as in the case of tuberculosis, likely to hand on a specially susceptible constitution. It will be a good day for Eng-

land when every father asks the suitor for his daughter's hand not what his bank balance is, but whether his blood is clean: for more women have been ruined in health and more children doomed to a heritage of suffering through the neglect of this pertinent but not impertinent question than Nero ever butchered or Herod's soldiers slew. Of old it was said, " The fathers have eaten sour grapes, and the teeth of the children are set on edge," and the proverb still holds true.

With the advance of education and the dissemination of some knowledge of the laws of heredity public opinion is gradually becoming leavened by more sensible views about marriage; and in due time the possession of a certificate of health by both parties to the contract will be as necessary a preliminary as the proclamation of banns.

Though we have learned much about heredity, there are still many things about it that are obscured by impenetrable darkness, and its mysteries are so great that, were there no God, we should almost require to postulate one to explain them.

CHAPTER VII

MAN'S FREEDOM, AND MAN'S SOUL

"Man's Free-will is but a bird in a cage; he can stop at the lower perch, or he can mount to a higher. Then that which is and knows will enlarge his cage, give him a higher and a higher perch, and at last break off the top of his cage, and let him out to be one with the Free-will of the Universe."

TENNYSON. *Life of Lord Tennyson,* vol. i, p. 318.

"The thrall in person may be free in soul."

TENNYSON. *Gareth and Lynette.*

THE one fact of which we are certain is our own existence. We believe that other things exist besides ourselves. We see the sun, the moon, the stars; we are stirred to delight by the beautiful panorama of nature; we are jostled in the streets by other creatures like ourselves; but we can never feel perfectly assured that these things have a real existence of their own, independent of our consciousness of them. We know them only through the impressions they make upon our senses. But we are conscious of our own identity; we recognize that this identity is independent of time and change; we can control the movements of our limbs; we are free to choose one course and reject another; we can think in abstract terms, reason within ourselves, regulate our conduct according to the experience of the past, and formulate decisions upon moral issues.

There is an almost insuperable temptation to regard the body as nothing more than a great and delicately adjusted machine in which is at work a vast and com-

plicated system of wheels and springs, pumps and levers, pipes and valves, and wherein, as in a chemist's test-tube, marvelous chemical unions and dissolutions are perpetually taking place. Many of the processes of life may be expressed in mechanical and chemical terms; but, much as we may marvel at the wonders and potentialities of modern chemistry, we must pause before we can accept the idea that thought, volition, consciousness, are nothing more than the product of chemical changes. We cannot reduce to atomic equations and express in chemical formulæ the will to be ready to lay our lives down for a just cause; or all the mysterious beauty of maternal love. Nor can we reasonably imagine that the choice between moral right and moral wrong is to be determined by the combination of chemical molecules, or that hope is a nascent chemical product, and despair a chemical experiment gone wrong. Test-tubes and reagents do not supply us with an adequate explanation of the mental life of the individual: and, although one dare not affirm, since the opposite has been proved, that thought, emotion, and action are not attended by chemical changes in the brain-cells, we must guard against the danger of failing to discriminate between a phenomenon and its concomitants. The noise of a peal of thunder is a concomitant and consequence of the electric discharge that gives us the lightning; but the noise does not give birth to the thunder-bolt, nor has it any of its lethal powers.

Primitive man, pondering on the mystery of his shadow, startled to see his reflection look back at him with frightened eyes when he stooped to drink from some quiet pool, and amazed when an echoing rock flung his voice back out of the distance, early concluded that he had a double. This double was his

spirit or his soul. It was immaterial. It left his body at death, casting it aside like some worn-out garment. Without this soul he was a corpse; with it he was a sentient being.

The earliest philosophers believed that the soul was responsible for our mental life; that it gave us our thoughts, and, as thought was the loftiest activity of which the human being was capable, they imagined that the soul must be something of divine origin, some form of celestial fire sent down from heaven and incorporate in man — some breath or essence of the gods. Among the pagan philosophers Plato conceived of the soul as a charioteer, free, and capable of free movement, what time he directed and controlled the chariot of the body.

Some believe that the soul that is in man, or rather that is man, is a part of God himself, a fragment of the Godhead, imprisoned in our earthly clay, limited by its separation from the Divine Being, and shackled to earth by its material habitation. Others, who have only a hazy idea of God as a Person, regard the soul as a part of "the all," substituting a mere name of indefinite connotation for a principle that they are unable further to envisage.

Man shares many qualities in common with inanimate matter. He shares other qualities with the whole animal creation, but he alone, among the things of the earth, has the power of exercising free-will. He can choose between two lines of action; he can decide abstract problems; he can "eschew evil and do good." If he were matter, and matter only, such things would be an impossibility. Some physiologists deny that man has any free-will. They try to convince themselves that all his actions are automatic; that the central nervous system, the organ through which the mind ex-

presses itself, is little more than a power-house in which afferent impulses, or impulses coming from without through the gateways of the senses and along the conducting paths of the sensory nerves, are converted into efferent impulses which are transmitted through the outgoing nerves of motion and result in action. They do not allow that the individual will comes into operation at all. The efferent impulse which follows the sensory stimulus is conditioned by heredity, by education, by religious bias, by a thousand and one circumstances that may previously have acted upon a man or his ancestors, and made certain nerve-paths or certain nexuses between afferent and efferent impulses more easily bridged. So that, if I decide that I shall have tea for breakfast instead of coffee, I am not exerting any free-will, but my olfactory or gustatory end-organs, for some reason known only to the physiologist, are sending memory-pictures of the flavor of tea up to my central nervous system, and through the nerves that control the muscles of speech, without the exercise of any choice on my part, tea is being ordered. The brain becomes, therefore, little more than a telephone exchange, where the operator is asked through an incoming wire (an afferent nerve) to connect the speaker up with another number (an efferent nerve) and does so without exercising any discrimination on her own part. To express the problem in such simple terms is to reduce it to an absurdity.

What actually happens in the human mind when free-will comes into play is fairly well represented by the following illustration.

When a great battle is raging the general in command is at his headquarters behind the lines anxiously awaiting reports of how the fight is going. With his staff he has probably devoted days and weeks, possibly

months, of anxious and particular thought to the planning of his operations. At such and such an hour it has been decided that the artillery bombardment shall begin; at such a moment it shall enter upon a wild but ordered crescendo; and at a predetermined hour it shall reach its zenith, and then cease suddenly, and, at that moment, the officers in the trenches have been ordered to launch themselves and their men over the top. Instructions have been given down to the minutest detail. The goal aimed at has been defined. Certain regiments have been held in reserve, ready to lend help wherever needed. By runner, by despatch-rider, by carrier-pigeon, by telephone and telegram the general and his staff are kept fully informed as to how the day is faring, and as each report comes in a little colored flag is moved upon the map of the battle-field, so that, moment by moment, the commanding officer has before him a bird's-eye view of the situation. Suddenly a message comes that at a certain part of the line there has been an unusual resistance, the nature of which is tersely described. Such contingencies have not been unforeseen, and have already been provided for in the detailed plans which the general and his staff had prepared. It had, let us say, been already determined in consultation that if the advance were held up at this particular point, the artillery should be commanded to concentrate upon it. If the general were an automaton, hide-bound to principles that he had formulated, he would issue orders for the artillery to open heavy fire upon that place. But he considers for a moment, and then sends out instructions that the situation is to be relieved by bombing from aeroplanes or by whatever other method his experience as a strategist leads him to believe will give the greatest surprise, and have the most telling effect. He is not a mere auto-

matic center for the conversion of afferent impulses (despatch-riders' messages, etc.), into efferent messages along the path of least resistance, viz. according to predetermined plan. He uses his intelligence; he interprets messages, passes them quickly through the weighing-room of his reason, and decides by a definite act of free-will that he will depart from the plan already formulated.

The existence or non-existence of free-will in man is a matter of such importance, in the light of what is to follow, that it is entitled to further consideration. The problem is age-long, and has been the source of much perplexity, and it is worth noting that the greatest opponents of the idea have belonged to two opposite camps. The materialist, who explains everything in terms of matter and energy, reduces all human action to nerve reflexes, and holds that man can have no free-will because such an idea would contradict the doctrine of the conservation of energy. He trips into the pitfall of confusing psychological and physical activity, which belong to different planes. The other body of opponents belong to that school of theological belief which is chained to a crude and barbaric doctrine of predestination. They believe that whatever happens was and is predestined; they rob man of all freedom and make him the impotent slave of the will of God. For them man's free-will becomes a perilous delusion. But, as Dr. Denney has said: "Absolute predestination is not the explanation of anything in the moral world. The man who asserts predestination thus, without mitigation or remorse, has cancelled the world of history and experience." [1]

Neither the materialist nor the narrow theologian is

[1] *The Christian Doctrine of Reconciliation,* by the late Principal James Denney, D.D.

right. Man has free-will. And, having free-will, he is *ipso facto* something more than matter; for mere matter cannot have the power of self-determinism.

In animals all acts are the direct, immediate, and automatic outcome of stimuli. Where two stimuli act coincidently the animal responds to the stronger. There is no analysis, no reasoning, no delayed judgment.

The lizard basking on a sunny wall darts off when the shadow of a passer-by falls upon it. Here the impulse of fear has been strong enough to overcome the impulse to enjoyment produced by the warmth of the sun, and fear causes flight. Between the lowest forms of animal life and man there is a growing complexity in the response to stimuli, and among the higher animals one might almost imagine that some acts were not automatic and instinctive; just as, on the other hand, one must admit that human beings tend to become more or less of automata. Habit tends to make us surrender our free-will and to react in precisely the same way to the same or similar stimuli, so that, given certain conditions, our intimate friends can often predict what our conduct will be when faced by an emergency. Through the frequent repetition of certain acts, beaten paths of low resistance are driven through the tangled thicket of nerve-cells and nerve-processes in our brain and the connection between afferent and efferent centers is made easy. The impulse flows in, and finds an easy access to the efferent nerve, and passes out in action, without any intervention of the somnolent will. So that by failing to exercise our free-will, we reduce our actions to the level of mere animal automatism. But still we are definitely free, and even the most shackled slave of habit can and does break loose from his traditions, and, to the surprise of his friends, may assert his personality

in a new way by the exercise of his free-will. But we are only free when we exercise our freedom. It is a form of wealth which we only possess in the spending of it. We are conscious of it especially when we make a choice which entails a sense of responsibility. In our own minds we distinguish between a free-will act and one in which the obvious exercise of our freedom does not play a part.

It must be clearly understood that when we speak of the freedom of the will we are not blotting out all antecedent causes. Schopenhauer fell into this error. Our freedom consists not in the empty power of exercising a motiveless will, but in the liberty we have of choosing between different or conflicting motives, balancing them one against the other, analyzing them, inspecting them from every side, and then acting. Human conduct is the outcome of motives, just as animal action is the product of impulses. The animal acts on the strongest impulse; we act in response to the strongest motive, but (and this makes the tremendous difference), the motive upon which we act does not become the strongest until we have chosen it by the exercise of our will. Free-will enables us to choose the motive upon which we shall act; and when we will to act we do not do so, as it were, through the empty air. Once having willed, which is a purely psychological process, we must conform to biological and physico-chemical laws to translate our will into effect. We are conditioned by matter; we act through brain and nerve tissue.

There is a further great difference between the actions of animals, and the free-will activities of man. In the animal kingdom the response to the stimulus is immediate, but in man an impulse may be supplied, or a motive furnished, and action need not follow for

days or weeks. Judgment, reason, anti-impulsive effort have come into play. The matter is being considered. There is no parallel phenomenon met with in creatures lower than man. It is a phenomenon which is only possible among free agents. However many opponents the doctrine of free-will may have we must recognize that the whole fabric of society has been built up on the tacit assumption that man is a free agent. They reap the benefits which flow from a doctrine, translated into practice, in which they do not believe. Their position is somewhat untenable. If man has no free-will all punitive or repressive legislation directed against the wrongdoer is an insult and an injustice.

Though it is often difficult to tell where automatic action ends and free-will comes into play, it is more difficult to determine where man's freedom of will ends and the will of God comes into operation. We are face to face with a hard problem. If God is omnipotent and omniscient, and rules and controls everything, seeing the end from the beginning and antecedently determining all events, how can man have any scope for the exercise of his freedom? The difficulty seems insoluble, but there is a way out. It is to be found in the recognition of the fact, which experience and history both confirm, that God has delegated to man some part of His work in the world. He has made His creature in some sense a co-creator. He has not kept him as a puppet on a string, but has given him the golden gift of reason, with which to use his freedom and work out his destiny; and in working it out he influences his fellow-men, he fashions history. But the omnipotence of God is not ruled out in this, nor is His foreknowledge. Like a careful teacher who runs a rapid eye over the long calculation which has puzzled

and distressed a child, He sees where the error has crept in which might interfere with the correct result, and with a touch of the finger it is put right. Man's free-will used wrongly has sometimes introduced chaos into order, and almost ruined the world. And when this has happened God has frequently restored order by catastrophe.

We are so accustomed to admire the harmonious working of natural laws that we have become blind to the possibility of catastrophe being an instrument of God. Those who live on the edge of catastrophe, who witness it in operation, are too close to see it in correct perspective. It is only when such an upheaval is regarded down the long vista of the years that the control of the directing Mind behind it becomes apparent. All the witness of history testifies to the cleansing, revivifying, and correcting power of events which their immediate spectators considered to be world disasters. When God gave man free-will He embarked upon a great experiment; but He knew all the factors in the experiment, and saw how the misuse of the gift might lead to human pain and human suffering, and seeing, knew that now and then man's error would need to be corrected by upheaval and explosion.

Free-will is a function of the soul, for it is independent of those laws which govern matter, animate or inanimate. And what is the soul? It is that directive factor and controlling principle which is responsible for our personal identity, our expression of ourselves, our personality. Linked to the body through the mind and brain, it is the energic factor responsible for the weaving or development of the body along the lines set by species and heredity. That is on its lower side. It reaches down to the body, but it also reaches

up with expectant hands into the vastness of the Infinite, if haply it may touch the feet of God. It embraces the intelligence, the will, and the emotions, and it is the great reservoir in which we keep stored our mental experiences. And with and through it we worship.

The body, and, especially, the brain, are the physical organs through which it gets into touch with the material world. Through them it is brought into practical relations with the great physical realms of matter and energy. It can, though it is an immaterial and non-spatial entity, through using the body, itself a material thing, subordinate matter and energy to its own ends. But conversely it may be acted upon by material things as every one must admit who has felt his emotions stirred by a beautiful sunset, by such a piece of art as the Gothic façade of the Church of St. Ouen, or by the appeal of an exquisite harmony. The beauty of a sunset is a material thing in so far as it consists of waves of light, refracted, reflected, interfered with and commingled, and an exquisite harmony reaches our ears as rhythmic vibrations in the material fabric of the atmosphere. These sensory impressions conveyed through material channels, and consisting of energy expressing itself through matter, enter our brains as stimuli of sensation; but it is the soul, and not the brain, that interprets them and responds to their message in the up-welling of emotion. So it is apparent that the nexus and interaction between the soul and the body is an intimate one.

A soul of a kind may be incorporate in animals lower than man. Possibly a bird may praise God in its song, and may even worship Him, and a flower may pour its perfumed chalice at His feet; but creatures lower than man cannot distinguish between moral

evil and moral good. They can have no moral life, and it is in the moral realm that the soul becomes spiritually directed and can lay hold on God.

Sir Oliver Lodge has said: "Soul appears to be the link between 'spirit' and 'matter,' and according to its grade it may be chiefly associated with one or with the other of these two great aspects of the universe."

That the soul is a real entity, and not a mere imagination of the philosophers and theologians has been proved a thousand times for those who have eyes to see it in the trenches of Flanders and France. Over and over again the conditions there have been so appalling that if man were only flesh and blood he would long since have given up the fight. But his "spirit" — the soul in him — has steadied his body when the temptation was strong in him to turn and flee, and because he is a spiritual being and not a mere machine of flesh, his soul has triumphed and he has "stuck it" to the end. His whole physical being may have revolted, but the little spark of divine fire in him has won the day. When the Germans in a whirlwind rush were endeavoring to break through to Amiens, and by sheer weight of numbers were pushing back that gallant line which may bend, but never breaks, the great consolation offered by the war correspondents was that, though we were giving ground and losing men and guns, the "morale" of our soldiers was unbroken. Unwittingly they were paying a high tribute to the indomitableness of the soul, of which "morale" may be called an exhalation.

Among primitive peoples the belief in the soul is surrounded by all manner of superstitions. Any mystery tends to become weed-encumbered with such accretions. But the nucleus of the idea is there, and its

distribution is universal. And the idea is not confined to primitive people, but has received in all ages the intellectual assent of the noblest minds the world has ever known. If it were nothing more than a vain imagination it would long since have vanished out of human life. But it persists and has an influence as potent among thinking men to-day as it ever had. It commands their intellectual assent, and, what is more important, it shapes their lives, which it would never have done had it been a myth invented by some primitive thaumaturgist in order to secure ascendancy over his dupes.

In all ages it has had its critics who, like Voltaire, have sought with less reason and ridicule to pour contempt upon the idea, and shake men's faith in the existence of the soul. But, though the poison of their sophisms may have blighted some lives, they have never been able to kill the universal belief. They have been like a band of blood-thirsty school-boys pursuing with murderous but ineffective pebbles a beautiful and elusive bird.

We do not discover the soul under the microscope, nor in the test-tube in the physiological laboratory, nor can we with scalpel and forceps lay it bare in the dissecting room; but we can see it, even though our eyes are veiled, in the illumined lives of men and women, and we are conscious of its presence in our own being.

CHAPTER VIII

WHAT IS LIFE?

"A living dog is better than a dead lion."

Ecclesiastes IV: 12.

"Avec une force quelconque de la nature on peut obtenir toutes les autres, sauf celles qui animent les êtres."

DR. GUSTAVE LE BON. *Hier et Demain.*

WHAT is life? This is a question which has puzzled the physiologist, the psychologist, and the theologian. Each in his own way, using the terms of his own craft, has attempted to define it, but as yet no perfect and universally accepted definition has been reached. Aristotle spoke of it as "The assemblage of the operations of nutrition, growth, and destruction." Bichat called it "The sum total of those functions that resist death," and this definition, through its terseness, attained to a wide celebrity. But it is faulty, in so far as it fails to recognize that death is as much a phenomenon of life as is birth. Herbert Spencer defined it as: "The continuous adjustment of internal and external relations." But this is neither sufficiently distinctive nor precise. It has been said of all definitions of life hitherto suggested that they would apply to crystals as accurately as to living things.

Let it be at once admitted that neither science nor philosophy can tell what life really is. We know life only through its activities. Has it any real existence, or is it a thing vainly imagined? Matter we know only through the sensations it produces in us,

and our interpretation of them. It may have no objective reality apart from mind. The mind, which we cannot see, may possibly be the only real thing in the Universe; and our little lives, which to us seem charged with reality, may have no existence outside the mind of God. We, and the whole Universe as we see it, may be nothing more than thoughts passing through the mind of the Eternal. But can a thought be conscious of its own self? It seems impossible.

Life is something whose definition cannot be expressed in words. Words are dead symbols. But though it cannot adequately be defined, very serious endeavors have been made in all ages to explain it.

One of the earliest doctrines put forward to explain the mystery of life was the doctrine of Animism. Primitive man, as we have already seen, pursued in the sunlight by his shadow, early concluded that he had a double. This double was his soul or spirit, and he regarded life as the expression of the activity of his soul working through and making use of his body. This idea, no unworthy contribution to knowledge, ultimately became extended to all living things, animals as well as plants; and by a further extension there grew out of it the doctrine of the transmigration of souls, which is still held by many people. Early in the eighteenth century a German physician, philosopher and chemist, Stahl, enunciated a modernized theory of animism. He restricted the *anima*, or soul, to the human being, and made of it the governor of all bodily activities, from digestion to thought. It was the direct cause, without any intermediary, of all organic functions. Through it, according to Stahl, the muscles contract, the lungs expand, the heart beats. It is at once the captain, the engineers, the crew, the stokers of the ship, as well as being the ship-builder

and ship-repairer. The theory exposed itself to much hostile criticism, some of which was little more than ribald mockery; but the most serious criticisms came from the philosophers. They pointed out the extreme difficulty of establishing any direct action of the soul upon the organs of the body, because they belong to different spheres of being. The soul is a spiritual entity; the body is a material organization. Being such they cannot, the philosophers hold, directly interact upon each other. In their day Descartes and Leibnitz, perplexed by the same problem, had completely separated the soul from the physical body, and denied all direct linking and all interaction between one and the other, reducing their relation entirely to metaphysical conditions. They did much to establish a purely mechanical and materialistic conception of the nature of life.

Some forty years ago a serious attempt was made by a French physician, Chauffard, to work out a new, logical, and acceptable theory of animism. He regarded the soul as having dual functions. He attributed to it a mental, and a somatic or bodily side. Its mental side is involved in the consciousness of man, in his acts of thought, in the exercise of his will. Its somatic or bodily side influences the bodily processes not, as in the case of the animism of Stahl, by direct interference, but by unconscious impressions or influences exerted along the line of primordial laws. The distinction between Stahl's animism and that of Chauffard is perhaps a little difficult to comprehend. By Stahl's theory, the soul was the ship's captain; but he was the whole crew as well, doing everything himself. If he wished the ship to go faster he with his own hands stoked the furnace. According to Chauffard, the ship's captain engaged in none of these menial

but necessary activities in person. He lived on the bridge. He stoked the fire only indirectly by sending messages through the ship's telephone for "full steam ahead." The distinction is rather fine, regarded even in this material way. But this two-fold aspect or modality of the soul is capable of explaining the manifestations of all forms of life, in so far as it enables us to imagine vital activities carried on without consciousness, as, for example, in the lower forms of animal and plant life. It establishes between the soul and all life a possible continuity.

Opposed to animism was the doctrine of vitalism. Vitalism made of the fact of life a phenomenon apart. It separated it from the soul and from all non-living matter. It made of life something which could not be explained in terms either of the laws of physics or the laws of thought. The modern conception of vitalism still erects a strong barrier between itself and the psychical side, but the barrier between life and inanimate matter is lowered if not broken, and the vitalists of to-day see that physics and chemistry operate within the living body just as they do in the world outside. According to the modern advocates of vitalism, the vital principle watches over and directs the physico-chemical phenomena incidental to and necessary for life, but does not produce them. The early supporters of vitalism were apparently uncertain of what they intended their doctrine to mean. At first their "vital principle" bore a striking resemblance to the *anima* of the animists. When time and criticism had gnawed at the theory, the principle became something less easily comprehensible, and ultimately, instead of being a principle, it was reduced to a direction or plan according to which life conformed itself. Though reduced to these emaciated proportions, vitalism has

never completely lost hold, and to-day it has many adherents.

The third theory for the explanation of life is a purely materialistic one. Materialism holds that matter is the one and only ultimate reality. Let it be said, once again, that even a materialist would have no knowledge of this only ultimate reality without mind, which reveals it to him. According to the materialistic doctrine life is the sum total of all the physical and chemical operations taking place in a living body, be it a blade of grass or an intelligent, reasoning human being. From the remarkable phenomena of disintegration and integration constantly in progress in the leaves of a tree, right up to the highest mental functions of the philosopher, speculating on lofty moral problems, judging between right and wrong, passing his conduct through the crucible of conscience, all can be reduced to purely material terms, and explained as the outcome of the interaction of material atoms. Crude and repulsive as such a conception must seem to any one who has lived even for a moment in the vibrant atmosphere of an altruistic emotion, it cannot be denied that there is much about life which lends buttresses to the doctrine. But let us examine carefully what it means, and realize clearly what our adherence entails before we subscribe to it. If we accept the materialistic doctrine of life we automatically bind ourselves to the belief that the human body is nothing more than a machine, and that all its activities, from the lowest to the highest, can be written down in terms of physics and chemistry. Let it at once be admitted that many of the functions of life are purely mechanical, and that the laws of physics and the laws of chemistry are constantly in operation in a living being. But a living being is not a machine. For what ma-

chine, in process of operation, not only performs the work set it to accomplish, but at the same time keeps itself in repair, controls its own activities, adjusts itself to new conditions, and, instead of dissipating energy as it functions, can actually accumulate energy? And what machine can build and assemble itself? The primitive cell from which a human being originates grows and divides, grows and divides again, and after a long series of operations ultimately appears as a beautiful child, perfect in limb and body. The materialist would have us believe that all this complicated series of wonderful and purposive phenomena was brought about by the action of the ambient media, or, in other words, the appropriate environment upon the inherent physico-chemical properties of specialized protoplasm. Even in the world-famous works of Mr. Ford no motor-car has yet built itself up from a single nut, without the intervention of an intelligent mind working from without. But, it may be said, such a comparison is unfair. A nut or bolt from a motor-car is a lifeless thing; a speck of protoplasm has life, and it is that which makes the difference. That is sufficiently obvious to every one. What one should like the materialist to explain is by what interaction of matter, by what physico-chemical changes within its substance, by what influence of its ambient medium did the protoplasmic cell become thus endowed? If he cannot carry his theory back and explain things from the beginning, his idea falls to pieces like a house of cards.

There is another serious objection which may be urged against this mechanistic idea of life. If the body is a machine, it is the only machine which consists entirely of the agents from which it derives its

motive power. No motor-car was ever made of petrol; no steam-engine consists of coal and water.

Plausible though it be, the theory cannot stand as it is at present held by the majority of materialists. There is still something lacking.

As has already been said, many of the phenomena of life, if not all, are accompanied by physico-chemical changes. Some of the physico-chemical changes are well recognized, and may be carried out in a test-tube. But, though physics and chemistry certainly play a great part in the economy of the body, they do not explain life, and a living being, in virtue of life that is in him, can do things in direct opposition to the recognized laws of both these sciences. Kill a man, and unless his body is supported, it will fall to the ground. Gravity, a physical principle, has pulled his body down. But a living man is able to some extent to oppose himself to the force of gravity. He can raise himself, and stand erect. Or fill a test-tube with boiling water and keep it in a room where the temperature of the atmosphere is only 40° Fahrenheit. In process of time, if one immerse a thermometer in the water, it will give a reading which corresponds exactly with the temperature of the surrounding atmosphere. But place a healthy man anywhere on the face of the globe — in the Arctic circle, or on the equator — and with a carefully tested thermometer take his temperature under the tongue. The reading will be constant, viz. 98.4° Fahrenheit, or, if it vary at all, it will only be by a fraction of a degree, for the chemistry of living things enables the qualities of the living thing to remain identical even in conditions of change. So that chemical and physical processes, conditioned by the activities of life, differ from similar processes met

with in things inanimate. An undiluted mechanistic, physico-chemical, or materialistic conception of life, call it what you will, seems to present us with ever fresh difficulties.

When the microscope was first developed to that height of excellence with which we are familiar to-day, there were some who thought that the secret of life would be deciphered in the minute structure of the cell. But, marvelous though the results of microscopical investigation have been, and interesting as are the facts concerning the minute structure of the cell-nucleus, the spongioplasm and the hyaloplasm which patient, disciplined, and keen-eyed scientists have discovered, the secret of life has proved to be out of the range of the most powerful lens. From the point of view of the functional activity of the cell, microscopical research had been almost sterile. The microscopist has succeeded in examining the bricks and mortar, the rooms of the house, the furniture with which they are plenished, but he has not discovered the hidden inhabitant. So, in despair, he has been thrown back on the conception of ultra-microscopic corpuscles, such as plastids, idioblasts, plasomes, biophores — satisfying himself by coining Greek names to give a special dignity to hypothetical entities he cannot see, but must imagine, if the mechanical theory of life is to hold. It is not alone in the realm of metaphysics that the imagination is sometimes allowed to run riot.

It is interesting to remember that all the functions of the body which are absolutely essential for the maintenance of our life are, so to speak, automatic and outside our control. We cannot at will suspend or cause to cease the beating of our heart. We are unable, except for a brief period, to stop the function of respiration. We can exercise no voluntary control

over the activities of organs like the liver or the kidneys which are essential to rid the body of the poisons which it evolves by every act of life. Life is something elusive; it is meant to be outside our control; and though a man may, by laying violent hands upon himself, work such destruction upon his vital organs that the delicate mechanism is thrown out of action, and life can no longer go on, he requires to make use of some adventitious weapon; he cannot, by merely willing it, extinguish the vital spark within him.

From very early times it has been held that the controlling principle was situated in some particular organ or structure of the body. The Jews believed that it resided in the blood — a not unreasonable idea when we remember to what an extent animal sacrifice was an essential part of their religion. The animal whose throat was cut by the priest's knife rendered up its life as its blood flowed over the floor of the outer court of the tabernacle; and the worshipers came to identify the blood with the life.

At the end of the sixteenth century Van Helmont suggested that life resided in one of the orifices of the stomach. About a century and a half later, Dr. Lorry discovered that a very small wound inflicted at a certain point in the brain of an animal caused immediate death. This discovery provoked considerable interest, and the point in question became recognized as "the vital knot." The precise situation of this important spot was accurately described by Flourens in 1827. It is a small area in the floor of the fourth ventricle of the brain, close to the place where the eighth or auditory pair of nerves enters it. The point is very small, but its destruction brings about the speedy death of the animal. As, however, physiological research advanced it was discovered that this point was

not in reality the seat of life, but was only the area of brain-substance responsible for the automatic performance of the act of respiration; and it was found that this point might be destroyed, but the animal would continue to live so long as respiration was carried on by artificial means. One of the chief discoveries about life, which the research of the nineteenth century gave us, was the recognition of the fact that the vital principle is not located at any special point, but is distributed all through the body. Each organ lives its own life, and each cell in every part of the body lives its own life too. All these separate lives are individual but yet communal, and in a normal individual work together in perfect harmony. Life has been decentralized; it sits in no special throne, and though three organs, the brain, the lungs, and the heart, are of paramount importance to the bodily economy, not one of them can be said to be the home of life. Recent research has presented us with extraordinary results, and it has been found that, when the necessary conditions are fulfilled, body-cells and even whole organs will continue to live and perform their functions for prolonged periods after their detachment from the body proper. We are therefore forced to conclude that every organ and every cell in the body has an individual life of its own. The sum total of these individual lives, blended into harmony, makes the harmonious physical life of the individual. Life is not the unique possession of any one organ; it belongs to the whole.

This enables us to understand why life is so difficult to destroy. One may pound a clump of yeast-cells with a Nasmyth hammer, and yet they will remain capable of producing fermentation, which is one way in which their vital activity expresses itself. And

one may subject a human body to almost inconceivable mutilations, and yet life will continue. A very little thing may produce death: a crumb of bread in the larynx, a drop or two of blood oozing from a fragile vessel in the brain, a little clot from an inflamed vein, trapped in the meshwork of the lungs; but, on the other hand, very formidable wounds and very extensive injuries may be sustained, and still life may go on. Long before the world-war there was on record the case of a man through whose brain a crow-bar passed, and yet he continued to live; and to-day there are men moving about among us, apparently in perfect health, with bullets or fragments of shell in their brains, in their lungs, and in their hearts, and in every situation in the body where a wound was at one time regarded as necessarily fatal. For life can withstand many assaults, and accommodate itself to many strange conditions.

Can we get any nearer to understanding what life may be? The key is somewhere in the Universe. Let us look abroad.

The forms of energy met with in nature are many, and at first man was very slow to learn anything about them. Even now, though science has deciphered much, there are many of the pages in the book still unread. From the moment when the first man opened his eyes he became aware of the existence of light. But to discover what light really consists of was left to the scientists of the seventeenth century. Euclid, the mathematician, as was perhaps natural, was the first to point out that light travels in straight lines. Newton, between the years of 1666 and 1671, while his ideas on gravitation were maturing, turned his attention seriously to the study of light, and greatly increased our knowledge of it. Descartes had broken up a ray of

light by passing it through a prism into the primary colors of red, orange, yellow, green, blue, indigo and violet, and had pointed out that these were the colors of the rainbow. But it was left to Newton to explain the cause of the appearance of these different tints. He succeeded in demonstrating that so-called white light really consists of differently colored rays, which are refracted at different angles when they pass through a prism. At the same time Roemer, a Danish astronomer, was measuring the velocity of light, and succeeded in determining that it travels at the rate of 190,000 miles per second. More modern investigation has established the rate as being 186,000 miles per second; but, considering the quality of his instruments, Roemer's calculation was wonderfully accurate. These discoveries were made before the nature of light was known. Newton suggested that light was composed of innumerable infinitesimal and invisible particles, emitted by luminous bodies; a hypothesis that satisfied some of the facts. But Huyghens enunciated his undulatory theory, which teaches that light consists of vibrations or waves in the ether, started by all luminous bodies. This theory, now well established and elaborated by the work of Young, is still the accepted one.

Heat was another phenomenon of energy, and, although men were making daily use of it, their ideas of what it was were for long confused and perplexing. Bacon had suggested that it was a movement of some kind, but until 1798 it was generally regarded as an invisible fluid, which overflowed from hot substances, and could mix itself with the mercury in a thermometer, causing it to swell and therefore rise in the tube. That heat is really motion was proved by Count Rumford, largely in consequence of an accidental observation which he was quick-witted enough to pursue. In

a cannon factory in Münich he noticed that the metal-borer as well as the cannon became very hot as the grinding proceeded. Many men must have noticed this before. It was left to the genius of Rumford to explain it. He made a detailed and careful series of experiments, as the result of which he determined once and for all time that motion can be converted into heat. It was left for Sir Humphrey Davy to make the deduction, verified by experiment, that *heat* is *motion.* He described it as " a peculiar motion, probably of the corpuscles of bodies, tending to separate them."

To some inquiring Greek, whose name is lost to us, we owe the first discovery of electricity. He found that if he rubbed a piece of amber (electron) it would attract little pieces of straw and odds and ends of dry and light débris. It was apparently a very little discovery, something that any child might have noticed and laughed at; but it laid the foundation of all that has come or is yet to come for the benefit of humanity out of that strange form of energy we call electricity. In the first year of the seventeenth century Dr. Gilbert, an English physician, published his book on *Magnetism.* He had carried the work of the early Greek observer a little further, and his work was extended, widened and applied by Guericke, Du Faye, Franklin, Galvani, Volta, and many others, until in our own day there is hardly a field of human enterprise in which electricity is not impressed into service. We propel our trains and tramcars by it, we light and heat our houses with its aid, we may cook our food and drive our machinery by it, we can communicate with others in our own voice through miles of wire with its help, and we can transmit messages with the tap of a key from one end of the earth to another. It is one of the most potent and useful forms of energy known,

the applications of which we do not fully appreciate, and the possibilities of which we have hardly begun to guess at. And yet, until the beginning of the seventeenth century, we knew practically nothing about it.

The last quarter of a century has enriched us with three particularly valuable discoveries; viz. the X-rays, the Hertzian waves by which the messages of wireless telegraphy are transmitted, and the radio-active properties of radium and kindred substances. What benefits to humanity may yet come from these sources no one can tell.

This long digression, with its recapitulation of some of the elementary facts of physical science relating to energy in various forms, has been indulged in to show how very slow we have been to find out anything about the wonderful and mysterious forces with which we are surrounded. Much has been learned, but there is still much more to learn, and science may yet discover that there are powers and forces in the Universe which act upon this world and everything in it that are yet undreamed of. Since the days of Newton the study of the solar spectrum has had perpetual interest for the physicist and the chemist, and their studies have given to the world much rich information. But beyond the violet rays in the spectrum there is a long series of rays about which, as yet, science has little to tell us. They may be rays with infinite potentialities. Some of them, we know, have powers of heating. The others, though this is unlikely, may be inert and valueless. But it is known they are there, although their function is as yet unguessed. And there is presumptive reason for believing that there come to our little corner of the Universe, out of the vastnesses of space, other rays than those of the solar spectrum, to which as yet we are completely blind.

I believe that, sooner or later, life will be found to depend on one or other of these unrecognized rays; some form of energy, unique in character, which expresses itself through protoplasm and through protoplasm alone. As Huxley pointed out, protoplasm is the physical basis of all life, whether it be vegetable or animal. Protoplasm without this energizing ray is not life; nor is this ray, until it acts upon and through protoplasm, life as we know it. Within certain restricted limits, the chemical nature of protoplasm varies. All dead protoplasm, which is the only variety that we are able to subject to chemical tests, seems to be, so far as our knowledge will take us, identical in composition; but there are refinements which our crude methods do not allow us to determine. It is, however, generally believed that there must be as yet undiscovered distinctions between the protoplasm of, let us say, a fish, a snake, a bird, a horse, and a human being, and, further, there are possibly minute differences between the protoplasm found in the bodies of any two men. Only on such an assumption can the facts of heredity and the maintenance of characteristic differences between species and species be explained. But the differences are beyond the ken of present-day chemical methods. Now, I suggest that protoplasm, wherever found, becomes the receiver of the energizing activity of this special ray, and the manifestations of life appear. It will at once be urged that, if this be so, death either of plant or animal becomes an impossibility. Protoplasm is an essential part of the structure of both, and if this special ray automatically seizes upon protoplasm wherever found and charges it with life, how can anything die? The objection is a perfectly fair one, and it is well it should be advanced; but it is far from presenting an insoluble difficulty, and

in its solution we may discover why it is that disease can destroy life. Probably this life-ray only incorporates itself with and manifests itself through protoplasm with a certain very definite molecular composition. If this molecular composition is disturbed, if the chemical linking of any of the atoms is interfered with, it ceases to be protoplasm such as the life-wave can act through, and becomes the protoplasm of the chemical laboratory, which is dead. This opens up for us a new conception of how a lethal disease may act. All diseases due to micro-organisms, as has already been pointed out, are accompanied by the formation in the body of toxins or poisons. If these poisons can produce combinations with the protoplasm either of the whole body or of any organ that is essential to life, they may so alter the chemical composition of the protoplasm that the life-ray can no longer combine with and energize it. That the poisons of disease may link themselves in a very intimate and special way with protoplasm, we know from the study of diphtheria.

But, it may be asked, how is death from a mechanical condition such as is met with in a broken-down heart, or a ruptured blood-vessel in the brain, to be accounted for on this theory? The hypothesis still holds good. When the heart breaks down, what is known as back-pressure occurs, and the tissues become water-logged and dropsical. All the protoplasm in the body is then under abnormal conditions; it is bathed by abnormal fluids, which may interfere with that fine molecular adjustment of the protoplasm which is a necessary condition before the life-force will act through it, and so death supervenes.

The rupture of a blood-vessel in the brain will act, though more locally, in much the same way. The whole condition of the intracranial circulation is upset

by such an occurrence. Fine chemical changes may take place in some of the centers necessary for the maintenance of life; the protoplasm then degenerates and the life-ray can make no further use of it. Every case of death depends upon the involvement, primarily or secondarily, of one or other of the organs which are essential to life; and, on this hypothesis, all cases of death may be explained.

The theory also enables us to understand the decentralization of life, which has already been dealt with.

Further, it gives us a possible clew to some of the phenomena of consciousness. When an electric current is passed through a thick bar of copper the resistance offered to its passage is very low, and only a small amount of heat is generated in the process. But pass the same current through a very fine wire of copper or of platinum. Great heat is generated as the current endeavors to force itself through the resisting channel, and the copper wire may fuse, while the platinum glows with light. Consciousness has been described as "nerve glow." The limitations of language are such, and we are so bound, owing to our physical nature, to the material side of things, that we are driven to use the terms of the known for the unknown. We have no conception of what "nerve glow" is except by the use of a crude material analogy as above. But let us try to imagine, without pressing the analogy too closely, what differences might result from passing the life current through highly organized, possibly resistant protoplasm in the brain-cells, as compared with passing the same current through vegetable protoplasm. The conception opens up a vista of tremendous possibilities. Mind is rooted in brain. No one will deny that. A tree is rooted in the earth; but its leaves, its blossom, and its fruit owe but a little to

their connection with the soil. They derive far more from the limitless field of the atmosphere, and from the sun. Here, again, the necessity of using material analogies cribs and hampers the idea. If only we could divest ourselves of the necessity of speaking of things in terms of matter, it would be much more easy to make the meaning clear.

It is not hard to imagine that to many this theory of life may prove startling, and appear to be nothing more than sheer, stark, and naked materialism, flaunting itself unashamed. They have been brought up to believe, and they feel, with that unconscious discernment that knows more than science can ever teach, that life comes from the Creator, and that He holds in His hand the life of every one of His creatures. Let us at once agree upon the issue. The theory of a life-ray, or a life-giving wave or force, is far from being inconsistent with any ideas of the immanence of God in nature and in human life. Indeed, it is nothing more than an elaboration of that doctrine, and a further evidence of the fact that, in His dealings with the Universe, the Omnipotent works by secondary causes and conditions His activities according to principles and laws. For the materialist, there are only two real things in the Universe — matter and energy. But, so far as he has been able to examine them, these two realities are under the influence of certain laws. Where the materialist fails is in an inherent or assumed incompetence to see beyond the law to the law-giver. Matter, energy, and laws relating to both are the only alphabet in his book of nature. Rays from the sun, rays from the fathomless depths of the infinite, forces of attraction between planet and planet, star and star, as they roll on in the immensity of space, waves in the ether, rhythmic vibrations in the atmosphere, atom leaping to atom, leaves

turning to the light, all prove that God is immanent in nature, and for this immanence He employs what we call natural forces. Is it an impious assumption to imagine that when we come to consider life we shall find that the Creator is true to His own methods and uses a form of energy which we may call the life-force or life-wave to quicken protoplasm to activity? And this life-force or life-ray, call it what you will, remains in His own hands. As yet, science has not been able to detect it, or find means of measuring it, or reducing its operations to a written law. It is a special form of energy, and when man has combed the beach of that sea of infinite space which encircles the earth, and has found many more rich and amazing treasures than his intelligence has yet led him to discover, I imagine that the life-ray will still elude him. For it is a spiritual force, and with material instruments and material vision we cannot envisage the immaterial. Encumbered as we are by a physical body, our faculties of perception are limited by the crude agents which we must make use of to know anything; and there are many honest and anxious people who, try as they will, cannot comprehend the spiritual. They associate it with chicanery, with seances in mephitic rooms, with ghostly apparitions in haunted houses, and their reason rebels. But we must admit the possibility of there being in the Universe other things than matter as we know it, and energy as we conceive of it. Remember that light is said to consist of undulatory vibrations in the ether. Huyghens and the scientists of his day, and those scientists who have since investigated the marvelous properties of light, could not imagine undulation or wave motion occurring except in a medium of some sort, so they were compelled to postulate the ether. The only proof we have that light consists of undulations in the

ether is that it behaves as though it were. Take away the ether from the conception, and we are left with light — an undulation in nothing. The idea is inconceivable, because here again the limitations of language and the need of material concepts make it impossible for us either to comprehend or explain such a phenomenon. But light may be a form of spiritual energy which we, being linked to matter, cannot comprehend until we have linked it to matter as well.

We see the life-ray or the life-force in operation when we study living protoplasm. It is only when it has joined itself to the protoplasmic sponge-work of matter that our material vision can give us any knowledge of it; and the physico-chemical changes which we can observe all through living nature, from the unicellular monad up to man, are not life, but the functional concomitants of the life-ray as it expresses itself through its physical substratum. This shuttle of God darts through the weft and woof of protoplasm, weaving the fabric of life in ever-fresh beauty and variety.

CHAPTER IX

THE PHENOMENON OF PAIN

"Pain
Clings cruelly to us, like the gnawing sloth
On the deer's tender haunches."

KEATS. *Endymion.*

LIFE, itself a mystery, is lived in a thicket of mysteries, one of the greatest of which is the problem of pain. This mystery is of universal and perennial interest. It has been the subject of much thought, more writing, and endless philosophical discussion, but we are still very far from an adequate comprehension of its purpose. Some men have devoted years of patient inquiry and experimental research to the end that they might discover means of alleviating pain, while others, too often under the cloak of religion, have prostituted their intelligence to the invention of fresh and diabolical methods of inflicting suffering. Let the records of the Holy Inquisition and the Star Chamber, or the hoary dungeons of the Max Tower at Nüremberg, bear witness.

We shall see later that much of the pain and suffering that afflicts humanity is avoidable, for it comes as a natural consequence of the non-observance of certain well-defined and elementary laws of life.

Between the cradle and the grave most of us pass along some avenue of pain. For many, much of the way is darkened by mental or physical suffering; but for most of us the greater part of the way is traveled in comparative comfort, so that if, at the end of our journey, we could cast up a balance between the pleas-

ure and pain we had experienced the former would be found to preponderate. Between pleasure and pain there is a neutral state, namely, that of indifference. Pleasure and mere freedom from pain are by no means co-extensive. The neutral state intervenes, and in most lives bulks largely, shot through here and there by pain or illumined with the glow of pleasure.

At what precise level in the animal kingdom the capacity for pain-sensation first appears is uncertain. We have, however, good grounds for the belief that pain-sensation is a quality of feeling reserved for the animal kingdom, and does not appertain to any member of the plant kingdom. The strange and fascinating phenomenon exhibited by the leaves of the sensitive plant, which shrink from the touch, is not an evidence of pain, but is simply a reflex contraction due to a gross stimulation. For the registering and interpretation of a painful sensation a complex nerve mechanism which is not found among the members of the vegetable kingdom is necessary.

In the lower reaches of the animal kingdom this nerve mechanism is not highly elaborated, and there is evidence to show that the capacity for feeling pain is much lower among the invertebrates, or backboneless creatures, like the leech, the lobster, and the star-fish, than among the vertebrates. The capacity for feeling pain probably reaches its highest expression in the animal kingdom among the mammals, and touches its zenith in the case of a gently nurtured, intelligent, and delicate woman. Most women bear pain with considerable fortitude, and it has been suggested that their stoicism is due to a lessened perceptive power. This explanation of their courage is based upon an unchivalrous and unproved assumption, made by man.

Any one who has ever handled a spade has at some

time or other divided an earth-worm in two. The worm cannot, unfortunately, express in articulate speech its opinion of this experience, but the two halves of the sundered creature do not behave in a way that suggests acute pain. They wriggle off, usually in different directions, apparently little disturbed by this cataclysmic interference with their anatomy. Probably, since nerves and nerve ganglia have been discovered in the worm, this severance provoked an unpleasant sensation that may have amounted to pain; but we cannot imagine that the reluctant worm tugged from the wet earth in mid-April by some questing bird suffers, even in a minor degree, the physical agony experienced by some mediæval martyr on the rack, or that the snail, whose house of shell is dashed to pieces against a stone by a hungry thrush, suffers as much as some victim hurled down the Tarpeian Rock. Nor is it at all likely that Izaak Walton's frog, for whose welfare he showed such tender solicitude, enjoining all his disciples to "use him as though you loved him," suffered as much, when baited alive upon the hook, as does a man whose finger is caught in a suddenly closed carriage-door.

Warm-blooded animals suffer more acutely than cold-blooded ones, and the higher the development of the nervous system and the more cultivated the intellect the greater is the capacity for feeling pain.

The perception and interpretation of painful stimuli may be interfered with by certain mental or physical conditions. It is wrong to suppose that the stoicism of the early Christian martyrs was in any way due to their lack of capacity for feeling pain. They were probably as capable of feeling pain, under ordinary circumstances, as are the men and women of to-day; but the intensity of their faith and their condition of

religious exaltation were such that by what is called a "blocking" process the painful stimuli were shut out of their consciousness, which was wholly occupied with the rapture of devotion by which they were consumed. By a curious perversion of sensation, some of them are said to have declared that their torture gave them pleasure rather than pain. We read of men and women falling asleep while on the rack. This has been regarded as a singular proof of the triumph of human faith over suffering; but I am inclined to believe that the so-called sleep was in reality an attack of syncope, which mercifully descended upon the victim to protect him from his torturers for a little while. But, be that as it may, there is no doubt that religious exaltation may become a very powerful anodyne. In his picture of the martyrdom of St. Sebastian, Guido Reni gave permanent and beautiful expression to this fact. The somewhat girlish figure of the youthful martyr is pierced by arrows, but there is no look of anguish in the eyes, no graven line of suffering on the face, no tight-drawn stoical lips, no clenched and knotted hands. Instead we see a smile of seraphic confidence, the light of an unconquerable faith in the upturned eyes, and benediction flowing from the bound but open hands.

Most of us know from our own experience that concentration of the mind upon some engrossing occupation may render us temporarily insensitive to pain. Many a man has found relief from an attack of toothache or neuralgia in the pages of a good novel, and Dr. Robert Hall is said to have preached some of his most eloquent sermons while in the throes of renal colic — a particularly exquisite form of suffering.

We have it on the authority of John Ballantyne, who acted as his amanuensis, that Sir Walter Scott on many occasions was suffering acutely, probably from biliary

colic, while he dictated the enthralling romances of *Ivanhoe*, *The Bride of Lammermoor*, and *The Legend of Montrose*. But, when carried away by his subject, he would rise from his couch, and, utterly oblivious of pain, walk up and down the room pouring forth his flowing sentences and living in person the parts of his creatures.

These facts help us to understand why it is that in the heat of battle a soldier may receive a formidable wound, and, at the moment, feel no pain. I have asked many of the wounded, both officers and men, to tell me as accurately as they can recall them, what their sensations were when they were hit. Almost invariably the answer has been the same, expressed, curiously enough, in practically identical language. Whatever the missile has been — shrapnel, shell-case fragments, rifle or machine-gun bullets — it did not at the moment of impact produce any sensation of pain. When the wound was felt at all it seems usually to have been as a dull, heavy sensation of weight or pressure, and many times I have been told that the feeling suggested a violent blow with the flat of a shovel. The sensation of pain did not arise till later, the length of the interval depending upon several conditions such as the nature and situation of the wound, and whether or not it permitted its victim to " carry on " or rendered him at once *hors de combat*. If he were able to carry on, and the fighting was stern, the development of the pain-sensation might be delayed for a prolonged period. If he were knocked out by the wound and compelled to lie still waiting for succor, the sensation of pain appeared fairly rapidly. In two classes of wounds, however, the sensation of pain was practically coincident with the reception of the injury. Men who have been wounded by a bayonet-thrust, or by the explosion of a hand-

grenade thrown directly at them, felt pain immediately they were struck. This fact may be explained as follows. In almost every case in which a man is wounded by a bayonet or a hand-grenade he sees what is about to happen, and his mind is already on the alert for the sensation of pain, which travels unhindered along the nerve track to the sensorium in the brain, and is at once perceived. Vision and anticipation have cleared the nerve paths so that the message of pain gets free access to the brain at once. In a battle a man does not see the machine-gun bullet or fragment of shrapnel that is whizzing towards him, so that his brain, engrossed with other things, is not watching for the sensation of pain. So when the blow comes it is a sensation of heaviness, and not of pain, that first reaches his consciousness.

In the course of my inquiries into this matter I received from a young officer a testimony so remarkable as to be almost unbelievable. In fairness it should be stated that when he volunteered a description of his experiences he had not the slightest idea that I was specially interested in the question of pain, and therefore his statement was not colored by any desire to give me the answer I expected.

He was hurrying back from the fighting-line to bring up reinforcements to a hardly pressed post, when he was hit by fragments of one of our own high-explosive shells which had exploded prematurely. He sustained very formidable injuries to the lower jaw and also to the chest, his jaw being shattered and his chest and right lung penetrated by a " through-and-through " wound. He says: " I felt no pain. I felt that I had received a dull, heavy blow on the face, and I dropped forward on my knees and collapsed like a burst motor-tyre. I was quite unaware that I had been wounded in

the chest, and during the half-hour that elapsed before I lost consciousness I felt absolutely no pain. Then I forgot everything, and remember nothing more till I woke five days later to find myself in a comfortable hospital bed. Until I lost consciousness I was quite aware of my surroundings, and remember distinctly having my gas-mask removed for me, and finding my mouth full of blood. I was alert enough to have felt any pain if there had been any to feel. The truth is, there was none."

This statement is all the more remarkable because of the situation of one of the wounds. The wound of the face and jaw was in the area from which the fifth cranial nerve collects its stimuli, and any one who has had toothache, or has had a sensitive tooth in the lower jaw prepared for filling, knows in what sharp accents of pain that nerve can express itself. On *a priori* grounds one might think that such a wound in the collecting zone of this nerve must of necessity be exquisitely painful. But it was not so. His loss of consciousness was not due to pain, nor was it, I think, altogether due to concussion of the brain, or it would have followed immediately on the reception of the injury, but from loss of blood, and interference with his respiratory functions through the temporary disablement of his penetrated lung. It may be that the absence of immediate pain in such formidable wounds is due to the fact that the blow sustained is so severe that the nerve-endings, which are the chief collectors of pain-stimuli, are completely stunned, and that, if one may so phrase it, a loss of local consciousness is produced. But, whatever the explanation, it is a remarkable and beneficial provision, for, at the moment, the presence of pain would have neither a remedial nor a diagnostic value.

Profound fear may modify the perception of pain either by heightening it through apprehension, or lowering it through the preoccupation with which it fills the horizon of the mind. A thoroughly frightened child has been known to run with bare feet along a road strewn with sharp-edged broken stones, till its feet were torn and bleeding without feeling pain in the slightest degree; and which of us has not discovered that the speediest cure for toothache is to ring the dentist's bell? Intense emotion of any kind, such as great joy or wild anger, may act as an anodyne to pain, and diseases accompanied by profound toxæmia or blood-poisoning may so dull the consciousness that it remains unaware of a painful stimuli.

Hysteria, neurasthenia, and that peculiarly distressing variety of nervous disorganization known as " shell-shock " may give rise to anomalies of sensation. In some hysterical people large areas of their skin become quite insensitive, and may be rudely stimulated in various ways without any pain resulting, and I have seen a soldier suffering from " shell-shock " whose capacity for feeling pain was so interfered with that the skin of his legs might be pricked in a hundred places with a needle and yet he declared that he felt no pain.

Just as the capacity for pain-sensation may be diminished by certain mental states, so also it may be raised, so that a stimulus which at ordinary times would not provoke any discomfort is registered by the perceptive faculties as highly painful. Hysterical and neurasthenic patients, though they may have in some cases a diminished capacity for feeling pain, more often, perhaps, react in the opposite direction and become extremely sensitive to stimuli of ordinary intensity, which may be interpreted when they reach the higher centers as acute agony. Patients falling into this category

suffer from what is called subjective pains, or pains for which no external cause is discoverable. These pains are a product of disordered mental action, and play a great part in the life of the unfortunate victim of hysteria, in whom they are constantly changing their situation, their intensity, and their kind. Behind them there is some deviation from normal mental equilibrium, whereby minor impulses are misinterpreted, and what would in a normal individual be regarded as nothing more than a slight irritation is magnified into excruciating torment. These subjective impressions of pain are due to faulty associative memory. The stimulus reaches the brain, but the associative center makes the wrong response; just as the operator at a lantern may receive the signal from the lecturer, and throw the wrong picture on the screen. This may seem a little obscure, but will be explained more fully in what is to follow.

The apprehension of pain, reinforced by the memory of previous experiences tends, as every school-boy knows, to heighten pain. A certain eminent judge, long since gone to his own Great Assize, who was a firm believer in the salutary effect of corporal punishment for a certain class of crime accompanied by violence, made great use of this psychological fact. He was accustomed to sentence criminals to be flogged, but, with a refinement of cruelty which one hopes, for the honor of the English Bench, was not intentional, he used to divide the administration of the lash into two or more doses, to be given at intervals during the culprit's incarceration. So that, to the physical pain of the flogging, was added the mental torture of the apprehension which preceded the second or third administration, such apprehension being heightened by the poignant memory of the previous experience.

Physical conditions, almost as much as mental con-

ditions, may increase the capacity for feeling pain, and a person reduced in health by a wasting disease, by anæmia or debility is much more intolerant of pain than one in the enjoyment of robust health.

Painful impressions linger for a time in the mind, but a merciful forgetfulness tends to sponge them off the tablets of the memory, and recollection is unable to recreate them again. This is peculiarly true of the pains of child-birth. Usually severe and sometimes intensified to the limit of human endurance, the memory of them is, in most cases, short-lived, and the evangelist exhibited a shrewd knowledge of life and psychology when he wrote: "She remembereth no more the anguish, for joy. . . ."

As the mediæval torturers well knew, repeated stimuli, not one of which in itself is sufficiently powerful to provoke pain, may by their constant repercussion give rise to acute suffering. This physiological fact lay behind that cruel device whereby a drop of water was made to fall from a height at short but regular intervals, either upon the same spot on the victim's forehead, or between his shoulders. One drop had no effect; a hundred successive drops could be borne without the least discomfort; but when the tale ran into tens of thousands, each limpid bead struck the shrinking skin like a lash of wire, and the torture, if continued long enough could break the spirit of the strongest. Here practice, as so often happens, was preceding scientific knowledge, for it was not till long afterwards that the physiologists enunciated and were able to explain the principle of what they call "summation of stimuli." The explanation of the phenomenon is that the receptive centers in the cerebral cortex, or outer layer of the brain, have not recovered from the previous stimulation before the next arrives. There is a residual

stimulation still in action when the next sensation arrives, and the effect on the brain-cells is cumulative. Consequently severe and progressively increasing pain is felt.

One may explain this by a simple illustration. Let us imagine that the cell or group of cells in the brain which is receiving the repeated stimuli is a cistern fed by a pipe which delivers a somewhat larger quantity of water than is able to escape in the same time through an outflow pipe. If we imagine that the cistern holds forty gallons, and that the inflow per minute exceeds the outflow by half a pint, a time will come when the cistern is filled to overflowing. It contains as much as it can hold. It has been filled gradually by the accumulation of the differences between intake and outflow. Similarly, a point is reached in the case of the group of sensory cells in the brain when they become "filled" with the accumulated residues of repeated stimuli, and react violently by overflowing in a sensation of severe pain.

The interpretation put upon painful stimuli by the brain differs in kind, and, consequently, several varieties of pain are described. Thus, we speak of a burning pain, and a pressure or tension pain. These qualifying adjectives give us a clew to the origin of the sense of pain, which is largely a matter of the interpretation put upon a stimulus by the centers of association and memory.

The locality in which a pain is felt is usually the seat of the mischief which is giving rise to it, and a person in normal health, whose nervous system is sound, has no difficulty, even when blind-folded, in locating the spot at which the pain arises. But this is not the invariable rule, and sometimes the situation at which pain is felt is a long way from the site of the disease responsible for its production. For example, many a

child whose gastric organs are in a condition of sound health complains of a frequent and severe stomach-ache. In reality he is suffering from disease of the bones of his spine, and the sensory nerves which are entering the spinal canal from both sides of his body are being irritated, either jointly or singly by pressure or by inflammatory products. Sensory nerves tend to refer all sensation to their extreme periphery, and the pain which in such a case really originates in the back, is referred to the nerve-endings over the anterior abdominal wall. In like manner, a child who complains of a chronic pain in the knee may really be suffering from disease in the hip-joint. It is a matter of common knowledge that men who have lost a limb will sometimes complain of pain in the foot or toes that have long been separated from the body. I have recently come across several instances of the kind among wounded soldiers, one, who had suffered amputation above the knee, assuring me with many protestations that he had been unable to sleep because of acute rheumatic pains in the ankle-joint and foot of the absent limb. He suggested, with that humor characteristic of the British soldier, that the leg which he had lost on the Gallipoli peninsula must have been laid to rest in a damp grave, and was lodging its complaint in this practical but unpleasant fashion with its former owner. Cases of this kind are capable of a simple explanation. Some slender filament of the nerve that once acted as the conductor of sensory impressions from the foot to the spinal cord, and so onward to the brain, has become imbedded in or adherent to the scar-tissue in the amputation-stump. Slight variations in the condition of the scar-tissue may stimulate the adherent nerve-filament, and cause it to send a protest of pain to the terminal sense-organ in the brain. But

this organ has all through the person's life been accustomed to docket every message coming along that nerve as a message from the foot, and a life-long habit is not easily broken. So, though the foot is no longer there, the brain cells which receive the message report to the consciousness that a pain signal has come in from the foot, and unless the mind bestirs itself to verify the message and its source, the point of origin and the seat of the pain are not accurately identified.

Another anomaly of sensation is explained by the overflow of excessive stimulation from one cell to another. Toothache sometimes affords us an example of this phenomenon. If a tooth is decayed, and the sensitive pulp is exposed, any irritation applied to it is conveyed to the brain, and recognized as dentalgia. If the irritation is very severe or prolonged the pain which at first was localized to the offending molar may spread to adjacent teeth, or even to the whole of one side of the face. This condition has been brought about by the overflow of excessive stimuli from one group of cells in the brain to another group of adjacent cells which are the terminal receptors of sensory stimuli from other branches of the nerve. These freshly involved receptors refer the commotion which is disturbing them to the terminal ends of the nerves which usually supply them with sensory impressions, and consequently all the teeth on one side may appear to ache.

For purposes of diagnosis and description it is the custom to regard the spinal cord, that great main route of communication along which motor impulses descend from the brain to the muscles of the trunk and limbs, and up which pass all the sensory messages sent from the periphery to the brain, as consisting of a series of super-imposed segments which are numbered according to the particular bone in the vertebral column behind

which they lie. This segmental division is artificial, because no segment is self-contained; but it serves a useful purpose for the localization of the processes of disease in the cord. It has been observed that if a sensory nerve which enters the cord at a certain level is inflamed, or under the influence of a disease which produces pain, those areas of the skin which derive their nerve supply from the same segment of the cord are liable to become sensitive to the touch. Of this fact we have a striking proof in the condition known as *angina pectoris*. The sympathetic nerves which supply the heart arise from the segment of the spinal cord which innervates the upper part of the chest wall and the inner side of the arm with nerves of sensation. An attack of *angina* gives rise to stimuli which pass from the heart through the sympathetic nerves to the spinal cord, and the sensory nerves associated with the same segment of the cord react to the stimulation and the patient is conscious of acute pain in the chest-wall over and above the heart, and along the inner side of the left arm. It is a little difficult to present these facts in such a way that they can at once be apprehended by those who have not an elementary knowledge of physiology, but an illustration may serve to illuminate the matter. When a large stone is dropped into the still water of a well its impact produces a splash, and from the point at which it breaks the surface an eddying series of concentric waves ripple to the margin. These are visible to the eye, but in its downward passage through the column of water to the bottom of the well the stone produces the invisible but none the less real disturbance in the hidden depths. This troubling of the waters is analogous to the effect produced by the sudden impact of a violent sensory stimulus impinging upon a segment of the spinal cord. The water of the

well down in its depths is driven into the crevices between the stones, and the nerve impulse in a somewhat similar way produces a disturbance some of which flows out through the channel of other nerves attached to the same spinal segment.

So far we have not attempted to define what pain is. Like life itself, like death, like matter and mind, and time, and many other of the commonest attributes of existence, it is extremely difficult to enclose within the terms of a definition.

Cicero described it as an unpleasant movement within the body, confusing the resultant motion which often follows pain with the sensation itself. Schopenhauer believed it to be a "negative experience" — that is, negative in contrast to an antecedent "positive experience" of pleasure; and Spinoza regarded it as "an emotion whereby the body's power of activity is diminished or checked." None of these definitions, however, is satisfactory. We must recognize that in pain there are two conditions; one physical, the impact of the stimulus upon the sensory cells in the brain, and the other metaphysical, the perception of the stimulus and the interpretation and classification of the sensation with the aid of memory and the association centers which communicate it to the mind. It is not in itself a definite entity. It may be called "feeling-tone." It is the mental interpretation of a sensation provoked by a peculiar quality or intensity of stimulation. There can, therefore, be no pain, without consciousness.

But, difficult though it be to define pain, no definition is necessary, since its distribution is universal, and we have all experienced it. We may not know how to imprison it in a phrase, but we all know what it feels like, and it is infinitely easier to philosophize about than to bear.

CHAPTER X

THE MECHANISM OF PAIN

"What a piece of work is man!"
SHAKESPEARE. *Hamlet.*

PRIMITIVE man regarded pain as the work of evil spirits, and prehistoric skulls have been found bearing the marks of trepanning, an operation that probably had been performed to allow the spirit of headache to escape from the skull of its victim. At the present day the Andamanese attribute all their pains to the activity of spirits, and in Malaysia there is a special spirit of stomach-ache.

Physiology, however, has taught us that pain depends on something else than demonic interference, and has worked out the mechanism through which we feel pain.

When we prick ourselves with a needle or accidentally burn a finger with a match we experience a highly disagreeable sensation, but underneath that sensation there lies a whole series of physiological processes which must be explained one by one before we can understand the mechanism by which we are made conscious of pain.

The skin is our chief organ for collecting sensory stimuli, and in this connection it is interesting to remember that the brain and the spinal cord are developed from the same layer of the embryo as is the integument. This ante-natal embryological connection explains much. Immediately underneath the superficial layer of the skin lie the terminal branchings of the sensory nerves. These end-organs of sensation are widely distributed, for all parts of the skin are more or less sensitive; but,

as every school-boy knows from practical experience, there are variations in their distribution, and underneath a square inch of skin from the tips of the fingers or the back of the hands, more of them are to be found than under a similar area of skin taken from between the shoulders.

When one of these end-organs is violently stimulated by any noxious agent a message is sent along the afferent or sensory nerve to which it is attached. This nerve, gathering tributaries as it goes, passes along the limb, and ultimately merges either directly or indirectly with one of the posterior spinal nerve-roots. The stimulus is thus conveyed to the spinal cord, up which it travels until it reaches the cerebral cortex or surface of the brain. Here it sets up a disturbance of a mechanical or chemical nature, but we are not aware of pain until the higher or mental centers direct their attention to the disturbance in the cortical cells and interpret it. It has now been definitely proved that molecular changes of a well-recognized kind are produced in the brain-cells of the cortex by the stimulus of pain. But these molecular changes are not pain, just as the tracing on the wax-cylinder of a phonograph is not music until it has been converted into vibration once again by the traveling style or needle and the sensitive tambour. The impression made upon the cortical cell is only a register: the registered impulse must be interpreted. It is translated by the higher centers of association and memory, and, after it has been examined, identified, and classified it is revealed to the consciousness of the individual. Let us personify the centers involved. The association center is suddenly awakened by a call from the brain-cell which the nerve impulse has disturbed. It says to itself: "There is a nasty commotion going on in the sensory cells that receive their messages from the right hand.

I wonder what it is: I seem to remember a commotion of this kind before. What was it then? Let me ask my sister Memory." Memory responds: "I know. That particular kind of commotion is only produced by burning. Don't you remember?" At once the association center and memory working together shout to the consciousness: "The fingers of the right hand are being burned," and consciousness commands the will to make the muscles of the arm contract, so that the hand is instantly drawn away from the flame. This series of operations, the examination of the effects of the stimulus, the calling in of memory, the joint arrival at a conclusion, the reporting to consciousness, and all the minute and undetected phenomena that go to make up a complex mental act takes place within the confines of the infinitesimal space of time that elapses between the application of the flame and the withdrawal of the finger. It is almost inconceivable that this should be so, and in dividing up and separating for purposes of greater clearness the various cerebral and psychic phenomena that occur, one artificially increases the difficulty of comprehending how so much can happen in such a little time. In actual practice the various stages in the process seem to run into each other instantaneously.

Sometimes, and possibly most often, the withdrawal of the finger is a pure sensori-motor reflex, which occurs while the message of pain is still on its way to the brain. Here the action is even more speedy than in the previous case. The sensory impulse from the nerve-ending in the finger runs up the nerve and enters the spinal cord; there, part of it runs round a nerve-arc to the motor-cells in the cord, and without the intervention of consciousness a motor impulse is sent from the cord which causes the fingers to be withdrawn. But part of the sensory impulse continues its passage

up to the brain, where it is recognized for what it is, viz. a sensation of burning, and revealed to the consciousness as such. In actual operation the spinal reflex discharges itself, and the sensory impulse is interpreted by the intellect almost coincidentally.

A wonderfully exact parallel exists between the mechanism of pain-sensation and the operation of a telephone.

When we speak into the transmitter of a telephone the column of air vibrating from our throat and lips communicates its movements, with all their nuances of accent, to a delicately poised membrane. The vibrations collected by this disc or membrane are conducted in the form of an electrical current along the intervening telephone wire to their destination. At the end of the journey the electrical current communicates to a disc in the receiver the impulses it has carried along the wire. The disc vibrates, and communicates its movements to a column of air which, striking on the drum of a healthy ear, delivers to the listener the message which may have been transmitted from a distance of many miles.

As is the case with the pain-stimulus impinging upon the brain-cells, the electrical stimulus striking upon the disc in the receiver and causing it to vibrate requires an intelligent and conscious mind to interpret it.

We all know at how many points the telephone may break down. The transmitter may be out of order, and cannot take the message; the wire may be down and the impulse cannot pass; the receiver may be damaged and fail to respond to the stimulus of the electrical current; or the listener may have a defect of his hearing apparatus, and be unable to catch and interpret the message we are eager to give. The possible interferences with the propagation of the sensation of

pain are analogous and equally numerous. The capacity of the end-organ in the skin for receiving stimuli may be reduced, *e.g.* by cold, by chemical agents such as cocaine, or by the processes of disease. The conveying sensory nerve — our telephone wire — may be cut in two, or its function may be interfered with by pressure either from a growth or from a tight ligature intercepting its course, or there may be gross changes wrought by disease in the spinal cord which interfere with its further progress. Or, finally, the receptive cells in the brain may be diseased or drugged and fail to respond by registering the impression, while at the same time the link between the cells of the cerebral cortex and the higher mental centers may be interfered with by disease, or by drugs such as alcohol, chloroform, or ether. The point to recognize and remember is that pain is not pain until it is perceived by the consciousness. All the physical phenomena by which it is brought about are purely mechanical interferences. At no stage are they pain until the consciousness has them revealed to it as such. If we could isolate the terminal end-organ of a sensory nerve and detach it from its connection with the sensory filament that conveys impulses from it we might subject it to all manner of noxious stimuli and no pain would be felt. Or if we could sever a sensory nerve from all communication with the brain we might pinch it with forceps, irritate it with chemicals, and sear it with the cautery, and no sensation of pain would follow. Similar assaults made upon an isolated segment of the spinal cord would also fail to elicit the response of pain, for the sensation of pain requires for its manifestation an intact nerve-arc with no break or interruption between the terminal sensory organ, or the nerve of sensation, and the higher centers in the brain.

On the occasion of a recent visit to my dental surgeon I was able to study in my own person the artificial interference with the mechanism of pain-perception produced by partial anæsthesia. He wished to drill a very sensitive tooth, and administered to me by the continuous method a mixture of nitrous-oxide-gas and oxygen. He had no desire to produce a condition of complete anæsthesia or unconsciousness; he wished to establish analgesia — or a loss of the power of perceiving pain. During the whole operation I was conscious of my surroundings. I could see, I could think and talk, I could hear the grating whirr of the burr and feel the touch of the operator's fingers. I could also feel a continuous sensation of commotion at the point where the burr was applied. I was conscious enough to be capable of analyzing my sensations, and the conclusion I came to while the operation was still in progress was that painful stimuli were reaching my brain, but owing to a breakdown, produced by the gas, of the nexus between the receptive cells in my cerebral cortex and my higher centers of association, I was unable to recognize the nature of the stimuli, and consequently felt no pain. The higher centers are always the first to be put out of action, whether the narcotic be alcohol, ether, chloroform or gas. The same is true in hysterical conditions attended by abnormalities of pain sensation.

Every nerve speaks to the sensorium in its own language. Ordinary nerves of sensation speak in the language of touch, of temperature-sense, or of pain. The nerves of special sense are monoglot. If one stimulate mechanically the second cranial nerve, the nerve of sight, it responds in the only language known to it, the language of light. That is why a sudden blow upon the eyeball causes one to see stars. There may be pain

as well from such a blow, but that is due to the coincident stimulation of some of the ordinary sensory nerves which supply the cutaneous structures adjacent to the eyeball. In the same way a violent stimulation of the eighth cranial nerve, the nerve of hearing, results in the production of a loud and unbearable noise.

One might reasonably expect that, as the brain is the central and necessary organ of sensation, any stimulus applied to it directly will provoke acute pain. But it is a fact well known to surgeons that the cerebral cortex may be touched, or cut, or seared in a conscious patient and practically no pain result. I have seen a surgeon pass a probe for two and a half inches into the brain of a semi-conscious soldier, without producing the slightest pain, while a stimulus of moderate degree applied immediately afterwards to the patient's skin provoked an immediate response of pain.

The explanation of this remarkable phenomenon is that those parts of the body most exposed to injury are the most abundantly supplied with those end-organs of sensation which Sherrington has called noci-ceptors. These noci-ceptors are scattered plentifully all over the skin. They are most numerous where the body is most vulnerable, for life and function must be protected. They are particularly abundant on the surface of such a delicate organ as the eye. A speck of dust blown by a March wind on to the conjunctiva — the delicate membrane which covers the organ of vision — brings this physiological truth forcibly home. As the brain is well guarded by the bones of the skull, and by the membranes that enclose it, it does not require so much protection from noci-ceptors. Consequently it is not so well supplied with them.

CHAPTER XI

THE MYSTERY OF PAIN AND SUFFERING

"Then, welcome each rebuff
That turns earth's smoothness rough,
Each sting that bids not sit nor stand, but go!
Be our joys three parts pain!
Strive, and hold cheap the strain;
Learn, nor account the pang; dare, never grudge the throe!"

ROBERT BROWNING. *Rabbi Ben Ezra.*

EVERY ONE who has devoted a moment's thought to the problems of life must have reflected on the purposes of pain. To the superficial it must seem a needless phenomenon, an experience calculated to increase the sum total of human misery, but altogether devoid of any beneficial qualities. To them it appears maleficent; an evil thing to be avoided at any cost; an invention of the devil. Such a view is directly opposed to the truth, for, as a matter of fact, the good qualities of pain more than outweigh the evil ones.

Pain is a sentinel which guards the outposts of life for us, and without it the citadel would be more easily overthrown. It is one of the greatest helps to the physician or surgeon in his work. The presence of pain, indicated by the sufferer, gives an immediate clew to the site of his trouble. The veterinary surgeon whose patients cannot describe in articulate speech the locality or the nature of the distress they suffer works at a disadvantage as compared with the physician whose patients are human beings. The former must rely on the secondary phenomena of pain to guide him to the site

of the mischief; the latter, by a few direct questions, can elicit from his patient not only the precise situation of his pain, but also some knowledge of its character and intensity. One of the most insidious methods of attack used in the present war is the gas-attack. Many of the gases employed are invisible, and their presence can only be detected by their smell, or by the effects they produce. Whenever a gas-attack is detected an alarm is sounded, and a rapid message passes along the lines and the soldiers put on their ever-ready gas-masks. Some forms of disease are as insidious in their onset as a gas-attack, and pain is the alarm which calls attention to them.

Let us take as an example appendicitis, a disease that of recent years has become very well known. Appendicitis is an inflammation of the vermiform appendix, a small blind tube attached to the large bowel. Its function is as yet undetermined, though it has been described by a medical student as "A trap for cherry-stones, and a source of income for the aspiring junior surgeon." Most probably it serves in the human economy as a *point d'appui* from which the contractions of the large bowel may start. In some animals, *e.g.* the rabbit, the vermiform appendix is of considerable size. In man its average length is 4–5 inches. But insignificant in length though it be, and obscure as its function is, it has a pernicious liability to become the seat of an acute inflammation which, if not dealt with promptly and efficiently, may bring about death.

The disease is attended by a number of symptoms, such as elevation of the temperature, quickening of the pulse, nausea, and possibly vomiting. These symptoms belong also to other diseases, and are not absolutely characteristic of appendicitis. One or more of them may be absent from an attack; but pain of an

acute character, concentrated at a special point, is one of the earliest and most indicative features of a seizure. The pain may radiate all over the abdomen, but there is one spot immediately over the appendix known as McBurney's point, where the pressure of a finger produces an acute and intolerable exacerbation of suffering. The character of the pain, and the definite localization of its point of maximum intensity, act as finger-posts which direct the surgeon to the appendix, and he knows that that vestigial organ is the seat of inflammation. But, in addition to its diagnostic value in appendicitis, pain has a protective purpose. Once the inflammation is established we find that there is a marked rigidity of the muscles of the abdominal wall overlying the appendix. Nature knows that the processes of repair are best carried on under conditions of rest, and the pain in the inflamed organ stirs up a reflex action in the spinal cord which throws the muscles overlying the appendix into a condition of board-like rigidity. This rigidity protects the appendix against sudden affronts from without, and also serves to prevent the weight of the bedclothes increasing the pain. The pain of appendicitis, so distressing for the patient, is therefore of great diagnostic value, and its presence may be the means of saving his life by calling immediate attention to the condition.

Occasionally the surgeon meets with fulminating cases of gangrenous appendicitis which are accompanied by little or no pain. These are the most formidable cases, and frequently terminate fatally; and a case of ordinary appendicitis in which there is a sudden and unaccountable subsidence of pain without a retrogression of the other symptoms of the disease is not welcomed by the doctor, though the patient and his friends may rejoice at the disappearance of the

suffering, and imagine, falsely, that it is of happy augury. Too often it means that, in the local conflict between life and death, death has been the victor, and may yet lay claim to the whole organism. Processes of disease which are normally attended by pain are, in the absence of that symptom, often very serious.

In diseases like the ordinary fevers, where the whole system is invaded almost at once by the infective agent, pain is reduced to a minimum. The infection, except in the early stages, is not a local one, so it is not necessary for pain to sound a clarion note of alarm, as the mischief has spread beyond the stage at which local treatment would be of much avail before the disease has declared itself. A moment's thought will explain why this should be. If systemic fevers were attended by severe generalized pain, the vital powers of the body would be lowered by suffering, and, consequently, the protective mechanisms which were described in a preceding chapter would not have a free and unhindered opportunity of playing their part. To take another illustration from the war: if England should, by an unhappy chance, be invaded, our defenders would not be helped but most seriously interfered with if any panic arose among the civil population. The invasion would best be dealt with if the whole nation kept calm, and directed all its energies to devising means of routing the enemy. Clamor and rioting in the streets, and craven fear in our homes, would be a poor backing for the soldiers who were rushing to the breach.

The records of the first case of a broken limb are lost forever, but it was pain which first taught primitive man the elements of a crude surgical practice. When some daring huntsman, in the childhood of the world, fell from a rock and fractured his thigh-bone, he very

soon discovered that any movement of the affected limb caused him to suffer acutely. At rest, the limb was fairly comfortable, a fact that he no doubt communicated to his solicitous friends who crowded round him awestruck by the disaster that had befallen him. It was but a short step from this discovery to the deduction that for him at least the best policy was one of masterly inactivity; and we can imagine that the women of his tribe, then, as now, instant to relieve suffering, would gather brushwood, or ferns or leaves and make a comfortable bed for the injured limb. As the days passed by the healing powers of nature would assert themselves, and a time would come when the limb could be moved gently without pain, and ultimately the sufferer would discover that he could use his limb once more. Like Jacob, he would probably halt upon his thigh for all the days of his life; but in his wrestling with God — his combat with pain — he had discovered that the best treatment for a broken bone is to immobilize it. The elaboration of a general principle from an isolated experience was probably beyond the wit of primitive man, but he had won from pain the nucleus of a great idea, which in the evolution of the centuries has fructified into that huge armamentarium of splints and cradles and pulleys that is the stand-by of the modern orthopædic surgeon.

The existence of pain has been a goad to urge men in all ages to seek for anodynes with which to alleviate it, and now, thanks to ether and chloroform, the most formidable operations may be performed while the patient is completely unconscious. The search for anodynes has been a very fruitful one, and the number of such remedies is year by year increasing. Some of the by-products derived from the distillation of coal-tar

have been found to possess pain-subduing properties in a high degree. This increases still further our debt to the sun.

The present war has confronted the surgeon with much more formidable wounds than any of which he had previous experience, and the change of the dressings required by these wounds has frequently been a very distressing experience for the unfortunate patient. But methods of dressing have been devised whereby the sensitive nerve-endings in the granulating flesh have been covered over with thin sheets of celluloid before the main dressings are applied; and, as a consequence, the patient is saved much suffering when the dressing is renewed. In this fact we see an example of the pain of the individual bearing fruit for the benefit of others. The first surgeon whose heart was large enough and whose mind was sufficiently alert to see in the anguish of his patient a call for him to turn his intelligence towards devising some means of sparing pain to others in like case was instrumental in converting vicarious suffering into a blessing. The history of the healing art supplies us with many instances of the suffering of individuals leading to discoveries rich in beneficence for the race. When Morton discovered the anæsthetic properties of ether he conferred an inestimable boon upon humanity, and it was his recognition of the importance of this discovery, and his large-hearted compassion for the individual sufferer under the so-called "primal curse" which led Simpson to embark upon that course of perilous and self-sacrificing research which culminated in the discovery of the anæsthetic properties of chloroform.

Pain, it is therefore seen, is something finer than a form of malevolent torture. It is diagnostic, it is remedial, and it is frequently life-saving. It confers

benefits upon the individual, and his sufferings, rightly read, may confer benefit upon a multitude. It is stimulative, disciplinary, and educational. The first child that scorched its finger in the fire has passed into a proverb, and so achieved immortality. In the history of man pain has been a touchstone which has enabled him to tell those things that are inimical to his well-being, and that might destroy his life; and through pain he has learned to avoid them.

To many, the reconciliation of the idea of an omniscient, omnipotent, and just Providence with the existence of pain seems an impossibility. They believe, with the old Greek philosopher, that, if there is a God who knows of human suffering and who cannot remove it, He is impotent. Or, if He knows, and can, but will not remove it, He is malevolent, or, what is almost as bad, does not care. It is an old, heart-torturing problem, but its solution cannot be reduced to such simple terms.

I am firmly convinced that, except in so far as it is beneficent, pain, either physical or mental, has no place in the scheme of things.

We must enlarge our horizon, and look at life as a whole; not the little life of the individual, which is a transient thing, but the life of humanity, which is continuous and of indefinite duration. That crude system of hedonistic philosophy which holds that pleasure is what gives value to life has failed because it is out of touch with reality. It is moral worth, moral progress, and, in the individual, moral character that give to life all that is best, and it is from the furnace of pain that some of those qualities have been won for mankind.

That the Creator has not willed, out of sheer malevolence, that man or any of His creatures should suffer hardly requires demonstration. For if this had been

His purpose He would have put out of human reach those many agents through which pain may be alleviated, and would not have permitted the curtain of a merciful oblivion to descend between a man and his most cruel pain. When pain passes the limits of human endurance the sufferer becomes unconscious: he faints. Man, looking at nature with a compassionate heart, but with somewhat distorted vision, is sometimes tempted to regard it as a huge arena that is the scene of unmitigated and constant suffering. And he cannot reconcile what he regards as the cruelty of nature with the thought of God. But is nature cruel? The belief awaits proof. The bird or beast of prey kills quickly, inflicting a minimum of suffering on its victim. The hawk and the lion usually strike but once. It is only when beasts of prey degenerate in character from their contact with man that they absorb some of his cruelty. The cat playing with the mouse is an abnormal example of how beasts of prey treat their victims. The domestic cat is well fed; its hunting has degenerated from a noble necessity of its life into a pastime, and it plays with the mouse because it is satiated and indolent. And we are not justified in imagining that the mouse really suffers during the time that its feline captor makes sport with it. The testimony of Livingstone and others who have been mauled by a lion is to the opposite effect. Always, in trying to estimate the sufferings of the lower creatures, we must guard against reading into their experience those mental or physical pains which we imagine we should feel in like case. Few animals have any apprehension of pain, while man increases his sufferings by dreading them.

The memory of the fear that has lent speed to a hare or a fawn pursued by dogs does not seem to be of long

duration. A hare or a deer will stop to feed, and a rabbit resume its gambols on the sand in front of its warren very soon after the danger has passed away. So, neither by anticipation or through retrospection do the lower animals increase the volume or intensity of their sufferings.

Much of human suffering is the direct result of the neglect to obey certain well-recognized or easily discovered natural laws. So far as one is able to observe it, the Universe is a great system controlled by law, which begets order and harmony. Even when the order is apparently broken by some chaotic upheaval we may find, if we look closely enough, that the upheaval is itself only a further demonstration of law in operation. If we will only bear this fact in mind we shall hold a clew to the explanation of much human suffering brought upon mankind by cataclysms or disasters.

After the great and historic earthquake at Lisbon, and the similar disturbances in Jamaica, at San Francisco, and in Sicily, within the memory of the present generation, men bitterly questioned the beneficence of Providence for permitting such loss of human life, and such distress and pain. They could not reconcile the idea of a God who cared, with such happenings. But they failed to realize the world-order.

The ultimate shape and form of the earth is not yet reached. Other mountain-peaks may yet arise from lowly valleys, and high hills may yet become the bed of unborn oceans. These cataclysmic convulsions of nature are as much part of the plan of the Universe in the making as is the life of man. But man has been endowed with reason, the gift of intelligence, the capacity for making observations and deducing from them some knowledge of the laws of nature. The knowledge of the laws of nature which man already possesses has en-

abled him many times, both in an individual and communal capacity, to avoid exposing himself unprotectedly to the full violence of certain natural laws in operation. For instance, no modern city in England would consent to draw its water-supply from a sewage-tainted source, for the connection between impure water, ill-health, suffering, and possibly death is well established. Nor would any man wittingly build himself a hut on an Alpine slope where avalanches are of frequent occurrence. If he did so he would have no just cause for upbraiding Providence for any disaster that might engulf him. So far as he is aware of them, civilized man does try to avoid coming into conflict with the larger laws of nature; but to expect that natural laws in operation, or upheavals that occur in consequence of natural laws, are to be suspended because man's knowledge has not yet advanced far enough to enable him to foretell where, when, and how every natural law will operate, is tantamount to asking that the Universe should stand still till man has learned the whole of its mystery.

In days before the war, which has to some extent given us new values and new visions, whenever the world was shocked by some great shipwreck, or by some stupendous conflagration attended with much loss of life, the sorrow of bereavement, and mental and physical pain, there was always, after the first stupor had passed, some raising of querulous voices, which asked, "Is there a God: and does He care?" As in most popular outcries, the feeling that prompted these outpourings was better than the logic behind them. To transfer to Providence the blame for human errors in judgment and in action, is to use a very weak argument against His immanence and beneficence. A shipwreck may occur because a ship was not built strongly enough

to weather the storm — a purely human miscalculation — or because it ran aground, or upon an unchartered reef — where, again, the human factor is in error — or because it was caught in such a storm that the officer in charge could not navigate it. If we are going to throw back on God the responsibility for these disasters we must, at the same time, be prepared to surrender all freedom of action, and consent to be reduced to the level of marionettes on a string. As we are reasonable beings, endowed with free-will, we are at liberty to place ourselves in positions where we may become the victims of natural forces, or of human errors in judgment. But it would be absurd to expect to be creatures with free-will so long as our freedom of choice operates only along the lines of safety, and at the same time look to have our freedom of choice forcibly suspended, or natural laws abrogated, whenever, in its exercise, we should unwittingly stray into the danger of incurring death or experiencing pain.

In small doses, that potent poison hydrocyanic acid will relieve an irritable cough; but if a patient, ignorant of the toxic nature of the remedy, should proceed on the assumption that, as a teaspoonful of a mixture containing this drug gives him a certain degree of relief, sixty teaspoonsful, taken at a draught, will give him sixty times as much relief, we should not be justified in expecting that, by a miraculous intervention, the drug will suddenly be robbed of its poisonous properties to protect the venturesome but unwise person from the consequences of his own misguided free-will. To look for anything of the kind would be to presuppose that God has nothing else to do than stand between man and the results that flow from his folly. But, it may be suggested, if the patient was unaware of the poisonous nature of the mixture, surely his ignorance, blossoming

into rashness, should not lead to his undoing if God really cared. The answer is not far to seek. The knowledge that hydrocyanic acid is a poison had already been acquired; that knowledge was accessible to the individual in question; that he erred through failure to inquire was his own fault, and not the fault of God.

The same line of argument may be applied to many of the events which have perplexed mankind. Larger, deeper, and better-used knowledge of natural laws, discovered or yet to be discovered, would in many a case have turned the sword of suffering from the bent neck of humanity. It is a poor appeal to make, that, until all the laws that govern human life have been reduced to writing plain enough for the blind to read, the pains and penalties that follow any breach of these laws should be suspended. Indeed, the existence of these penalties, the invariable linking of pain or suffering with a breach of these as yet undeciphered laws, is a goad to stimulate us to seek for the principle behind the process. In England great stress is laid upon the value of a public school education. The public schools of our country may not turn out many scholars, though it is possible for a bright and intelligent boy to pass through one of them and emerge with a heavy and partially assimilated load of educational lore. But in spite of their scholastic defects the education inculcated within their boundaries is the finest in the world, for it produces a splendid type of young manhood. To a very large degree this type of young manhood is the product of the unwritten code of laws made by the boys and handed on as a tradition from one generation to another. The laws of the Medes and Persians were unalterable. Neither these laws, nor the irrefragable laws that rule the Universe, are so adamantine as the boy laws of a public school. A newcomer may have some

knowledge of these unwritten laws inculcated into him by parents, by elder brothers, or by friends; but he best acquires a knowledge of them by breaking them unwittingly, and, though he may and probably does suffer in the process, it is all part of the discipline which, acting on his plastic character, molds it into the accepted type.

In the larger school of life the same process is at work if we would only recognize it.

Much of the pain in the world is attributable to man's misdirected ingenuity. He has always been prone to devise instruments of torture and methods of punishment that involve suffering. The rack, the wheel on which criminals were broken, the scourge, the martyr's pyre, the tread-mill, to say nothing of the thousand and one devilish devices of the Chinese torturers, were all man-made; and there is little doubt that the suffering inflicted by man upon man far exceeds in amount as well as in severity all the pain that has come to mankind from the operation of natural laws. As a nation we are accustomed to take pride in our civilization, but the student of our social history knows that our civilization was very slow to rid itself of studied cruelty. No one can read of the appallingly brutal punishments inflicted upon our sailors a century ago, or upon the soldiers who fought for us at Waterloo or in the Crimea, without his blood being chilled with horror. Man, who is sometimes tempted to think that God is malevolent, can be, and often has shown himself to be, more cruel than the arch-fiend.

We are slow pupils, and learn the lessons that are prepared for us haltingly and incompletely. This is true of the laws of health as well as of the larger laws of nature. But when we have learned, and care to follow with scrupulous observance, the proper conduct

of life, and regulate our hours of work, our hours of recreation, the nature and frequency of our meals, and those many activities that are part and parcel of our daily lives, our pain or suffering will be reduced to a minimum.

A difficulty that invariably confronts any one who directs his attention to the problem of pain is the suffering of little children. They are so helpless, so irresponsible for the ordering of their lives, and so very sensitive, that the pain they may be called upon to bear seems inexplicable on any basis of the right government of the world. It is little consolation to a child to suggest that it is suffering in order that the sympathies of older people may be quickened. I do not put it forward as the supreme reason for the sufferings of the young, but we must realize that through the pain of some children the sufferings of others have been assuaged. Any parent who has watched his own child tossing with fever-lit eyes in the throes of some painful and serious illness will forever after feel the claim of hospitals for poor children. If there had been no suffering among the children of the rich there would have been many fewer institutions for the relief of the pain of the poor.

We must not forget that much of the pain of children is brought about by wrong methods of nurture, or through carelessness, stupidity, and unnecessary exposure to infection by their elders. It is the old sequence once more: the broken law — the inevitable consequence. And, though it may be urged that the law is broken by the child's guardians, and the child suffers, while the guardian escapes, we must not forget that the mental pain, and the anxiety, amounting almost to torture, which any one feels when a child they love is seriously ill redeems the suffering from being

altogether vicarious. With our present limited knowledge the problem is insoluble, but we may rest assured that the pain of little children is no empty demonstration of vindictive power, but is something with a purpose behind it.

Most of the natural processes of life are unaccompanied by pain. A healthy individual should be quite unaware of the activities of his digestive organs, the expansion and contraction of his lungs, and the many other physiological activities of his economy. Pain, appearing as a feature of what are normal functional processes, is a sign that all is not well. But there is one great exception, so striking that, in the dawn of civilization, it was explained as an evidence of divine displeasure. Why should a mother suffer so intensely in the performance of what, after all, is a natural function, the bearing of children? This is a mystery as old as the human race, and its answer is not an easy one. Maternal love is a thing deep-rooted in primitive instincts; but there is little doubt that we hold dearest those things we have suffered to win, and if child-bearing were as simple a thing as growing flowers in a garden it is possible that maternal love, which is the prototype on earth of the high love of God, would not be an emotion so rich and beautiful. It receives a sacramental grace from suffering.

In some women the experience of motherhood awakens a compassion that embraces all suffering humanity. Let us hear a woman speak. I quote from *Robert Elsmere*. Catherine is slowly groping her way back to health after the birth of her little daughter. Her husband is sitting by her in the September twilight. She says: "Robert, I cannot put it out of my head. I cannot forget it, *the pain of the world!*"

"It seems," she went on, with that difficulty which a

strong nature always feels in self-revelation, "to take the joy even out of our love — and the child. I feel ashamed that mere physical pain should have laid such hold on me — and yet I can't get away from it. It's not for myself;" and she smiled faintly at him. "Comparatively I had so little to bear! But I know now for the first time what physical pain may mean — and I never knew before! I lie thinking, Robert, about all creatures in pain — workmen crushed by machinery, or soldiers — or poor things in hospital — above all of women! Oh, when I get well, how I will take care of the women here! . . . Oh, to give all one is, or ever can be, to comforting! And yet the great seat of it one can never touch. It is a nightmare — I am weak still, I suppose; I don't know myself; but I can see nothing but jarred, tortured creatures everywhere. All my own joys and comforts seem to lift me selfishly above the common lot."

As with so many, her personal share in common suffering had taught her to see the universal need. She was bound more closely to her fellows in affection and sympathy by this common bond. She was beginning to interpret the eternal lesson of pain.

But some part of the suffering of motherhood is not an inseparable concomitant of that natural function. The more artificial the life a woman leads, and the further she departs from nature in her manner of living, the more painful and perilous becomes the pilgrimage to the goal of her desire. It is rare for a primitive woman to suffer in anything like the same degree as a woman brought up in the hot-house atmosphere of an artificial civilization. For the primitive woman, too, motherhood has its pangs, but they are rarely intolerable; and when woman discovers and practices the proper rules of life, the sufferings of maternity will be materially reduced.

Pain is a consequence of the endeavor of life to adapt itself to its surroundings. When the adaptation is perfect there is no pain. This general principle is well exemplified in the sufferings of maternity. The child of highly civilized parents is likely to be born with a head somewhat out of proportion to the diameters of those bony channels through which it must pass; and this disproportion entails longer and more intense suffering for the mother. So long as women are content to develop their brains, and leave the physical development of their bodies to chance, their sufferings are likely to continue. But, let it be set down in all gratitude to those who have shown us the way, the more intolerable pains of motherhood may be assuaged and indeed lulled into absolute quietness by such a drug as chloroform. It is not the only anodyne that may be used for this purpose, but probably it is the safest and best alike for mother and child, and it has been an inestimable boon to suffering womankind.

So far I have said nothing of that other kind of suffering, as widely distributed and as poignant as physical pain, namely, mental anguish. Recent research has proved that mental pain is as real a thing as physical pain, for both are associated with precisely the same structural alterations in the cells of the cerebral cortex. But mental pain is a subtler thing than physical pain, and it may have disastrous consequences from which, as a rule, physical pain is free. Few cases, even of acute and prolonged physical pain, result in serious deterioration of health, or end by unseating the reason. Indeed, it has frequently been remarked that severe neuralgia may continue for a long period without any marked loss of physical condition on the part of the patient. But mental pain — the agony of torn and tortured affections, the acid-bite of remorse of conscience, the day-

long, night-long hunger of love unrequited, the hideous uncertainty as to the fate of some loved one, the shattering of hopes, the blind despair of unfulfilled desire, the darkening of the horizon through the loss of one's faith — may have profound effects, and produce such changes in the brain that for a time the higher functions of the mind are seriously interfered with, and the reason reels.

Except in such cases as its function is essentially diagnostic or remedial, physical pain is more beneficial to the community than to the sufferer; while mental pain is beneficial — unless it is so severe as to upset the balance of the mind — primarily to the individual, and secondarily through the effect it has upon his character, to those with whom he is brought into contact. Physical pain in another stimulates the sympathy of those around him, and quickens their intelligence to devise means of alleviating his suffering or discovering means whereby others may be saved from a like experience. It acts upon the sufferer in the way of making him more sympathetic to others in like circumstances with himself. He does not forget his own hour of trial, and, as George Eliot has said: "Pain must enter into its glorified life of memory before it can turn into compassion."

Mental pain is often a secret thing. It does not make the same clamant appeal to those around the sufferer, who hides "the pageant of a bleeding heart" within his breast. But out of it he may win two things. He may either emerge from the fire warped and embittered in character; or, as more often happens, he comes out as pure gold. Everything in life that is worth possession has come to us through pain. Life itself was won for us through pain, and for all the things that hallow life men have suffered and died. Liberty, freedom of thought, all that is best in litera-

ture, art, and song is stained with the blood and tears of souls that knew suffering, and filched from it those treasures they have given us to enjoy. Man's pain has meant his progress. Through it he has learned more than pleasure could ever teach him. The existence of suffering is a mystery, but without it earth would be a joyless place, and man would be without one of the greatest aids he has towards the perfecting of his character.

In moments of depression we are apt to imagine that we are like the starling in *The Sentimental Journey*, whose cry "I can't get out!" may be regarded as the wail of a soul that has bidden farewell to hope. But this is the creed of pessimism. As human beings, we must be prepared to shoulder our share of pain until perfect knowledge shall entitle us to lay it down. At this hour of the world's trial human pain and human suffering are more widespread and more urgent than they have ever been since the world began. All Europe is gripped by the hook of agony. Rachel is weeping for her children, and fathers who remember the glad and confident smile with which their boy set out to war are repeating in the silent chambers of their heart the psalmist's lament, "Would God I had died for thee: My son! My son!" What can it all mean? How can all this human suffering be transmuted into terms of moral value? How can it be justified? How can it be explained? Is there any light in the dark heart of the mystery? There is: and the light comes from those little white crosses which stand sentinel in Flanders' Fields above the dauntless dead. A wooden cross! To each, that symbol makes its own appeal and carries its own message. For some it is nothing more than a suitable and uniform symbol for marking a soldier's grave. To others it means infinitely more. It com-

memorates a victory — won through suffering and pain. It stands as the eternal witness to a tragedy, but it was no hopeless tragedy, since it bore within it the seeds of a Resurrection and of the grandest human hope.

It is and was a symbol of triumph, and a perpetual memorial of the unity in suffering that binds God and His creatures together. The mystery of pain loses its perplexity when we remember that, though man suffers, God has Himself come within the orbit of a like experience.

"The cry of man's anguish went up unto God;
'Lord, take away pain —
The shadow that darkens the world Thou hast made,
The close coiling chain
That strangles the heart, the burden that weighs
On the wings that would soar.
Lord, take away pain from the world Thou hast made,
That it love Thee the more.'

"Then answered the Lord to the cry of the world:
'Shall I take away pain,
And with it the power of the soul to endure,
Made strong by the strain?
Shall I take away pity, that knits heart to heart,
And sacrifice high?
Will ye lose all your heroes that lift from the fire
White brows to the sky?
Shall I take away love, that redeems with a price
And smiles at its loss?
Can ye spare from your lives, that would climb into Mine,
The Christ on His Cross?'"

CHAPTER XII

THE DISCIPLINE OF SICKNESS

"They also serve who only stand and wait."
MILTON. *Sonnet on his Blindness.*

"And not by eastern windows only,
When daylight comes, comes in the light;
In front, the sun climbs slow, how slowly!
But westward, look, the land is bright."
ARTHUR HUGH CLOUGH.

GOOD health is a blessing; ill-health may be a discipline. Few men or women succeed in living their lives from the cradle to the grave without some interlude spent upon a sick-bed. Our infinitesimal foes, the disease-producing germs, lying await for us everywhere, may succeed in invading the citadel of our bodies at a moment when our natural defenses are weakened. Or accident may plunge us from the rose-flushed mountain-top of vigorous health into the abyss and darkness of many a month of weary, couch-chained suffering. When the fight with disease is at its hottest there is little opportunity for cultivating those graces of character and mind that often flourish so beautifully in the atmosphere of sickness and personal suffering. But when the battle has begun to turn, when the convalescent awakes each day with a renewed feeling of well-being; when every sense reawakens tempered to a new keenness; when every little commonplace and familiar thing in the room is touched with a fresh light; when the perfume of flowers is like a eucharistic benediction, and even a

drink of cold water reveals a new, unknown, and hitherto unappreciated savor of pure delight, then the discipline of sickness has begun to blossom into beauty.

In these days we live at such high pressure that nothing but the seclusion of a sick-room affords us the opportunity of indulging in the almost extinct habit of reflection. It is there that a man can turn his thoughts from the outside world of material things, which, after all, are the lesser things, and, looking into his own soul, see what manner of man he really is. Many a compass has been adjusted in the silent hours of the night in a darkened sick-room, and many a course has been charted that has made for the happiness not only of the individual but of humanity. It may be the weakness that so frequently follows an illness, or it may be what the mystics called the purgative effect of suffering, but there is something in convalescence which makes an individual more susceptible to finer impressions. The spiritual fire flares up when it is least choked by the dross of the body. We see the beacon-fire more clearly in the darkness than in the full moon. The stars are in the sky all day, but they are invisible to our limited vision, unless we gaze upwards from some dark chasm, deep as a pitshaft.

More men than Newman have risen from a sick-bed to follow the gleam. That sweet and gracious personality, perplexed, distraught, entangled in a mesh of doubt, found on a sick-bed the fire of a new zeal. On his way home, after his journey to the Eastern Mediterranean with his friend Hurrell Froude, he was struck down by a violent fever at Leonforte in Sicily. He succeeded in reaching Castra Giovanni, where he was ill for nearly three weeks. On his recovery he set off for Palermo, and he tells how, " Before starting from my inn on the morning of May 26th or 27th I sat down on my bed and

began to sob bitterly. My servant, who had acted as my nurse, asked what ailed me. I could only answer, 'I have a work to do for England!'" His sick-chamber had been a temple of revelation. It had been what the road to Damascus was to St. Paul — a meeting-place with God.

An interesting book might be written to show how sickness, which has left behind it a permanent physical disability of some sort, has influenced the whole subsequent life of some of the world's greatest men. Homer, we are told, was blind. But it is unlikely that this blindness dated from his birth, for the exquisite appositeness of the descriptive terms which he applied to the beautiful things of nature cannot have been acquired at second-hand. The "rosy-fingered dawn," the "hoary sea," the "milk-white arms" of Helen, the "ox-eyes" of Athene, and all the natural beauties of the Isle of Calypso, so perfectly depicted, must have been visual memories, stored up, loved, and recalled with a kind of holy joy from the hidden recesses of the mind of one whom sickness or accident had made blind. Such things were not imagined; they must have been seen, and seen by him who first wove them into the fabric of his spoken verse — and seen again in the atmosphere of imagination with the clarified vision of one for whom physical sight was only a memory.

John Calvin, one of the profoundest thinkers and most voluminous writers that ever lived, had his outlook on life much influenced by all that he suffered in his body. He was a martyr to gout, he suffered also from stone and from biliary colic, he had frequent attacks of asthma and eczema, and there is little doubt that his whole theological outlook was tinctured by the influence of his ill-health. It tended to make him despondent. For many generations Calvin's theology

completely dominated Protestantism. Until recently it held almost undisputed sway in the religious life of Scotland, Wales, the evangelical section of the Church of England, the north of Ireland, Holland, and North America. It was founded largely upon the Pauline Epistles, but in his interpretations of the teachings of St. Paul he went farther than his master. It is hardly to be wondered at that a man who was called upon to suffer such constant and intolerable anguish in his frail body should have come to throw more emphasis on the juridical aspect of the divine character than on the divine love.

There is little doubt that if Calvin's health had been better his outlook on life and his interpretations of the decrees of God would have been brighter. One is shocked to think of the age-long mental suffering that Calvin's doctrines of Predestination and Election riveted upon the minds of the religious who were brought up in the atmosphere of his theology.

Sir Walter Scott was lame, an attack of illness when he was a child, barely two years old, leaving him with a permanently weak ankle. The literature of high romance owes more than is generally known to that attack of infantile paralysis. When all the vaunted surgical and medical skill of Edinburgh could do no more for the child he was sent to Sandyknowe, his grandfather's farm, in the hope that the purer air of the country might accomplish what science knew not how to do.

Nature failed to restore the withered limb. The child, however, improved greatly in health. But for that stricken limb it is almost certain that Scott would have become a soldier, and have fought under Wellington in the Napoleonic wars, when a bullet or a saber-stroke might have put an end to his career before he

had written a line. But his infantile illness did more for literature than merely to save Scott from the hazards of war.

His grandfather's shepherd, Sandy Ormiston, developed a strong affection for the delicate child, and used to carry him out on to the hills and lay him on his plaid on a sunny slope, where he would lie by the hour with the sheep and the lambs cropping the scanty grass round his resting-place. As he lay there this gentle shepherd would croon to him snatches of old Scotch songs, and tell him fragments of oft-told Border tales.

And in his poetry, his novels, and his *Tales of a Grandfather*, Scott in after-years was simply giving back to the world the ripened fruit that had sprung from the seeds sown in his receptive and fertile mind by the discerning love of this worthy old shepherd. Scott himself never forgot this indebtedness, and pays a tribute to it in *Marmion*:

> "Thus while I ape the measures wild
> Of tales that charmed me as a child,
> Rude though they be, still with the chime
> Return the thoughts of early time:
> And feelings, roused in life's first day,
> Glow in the line, and prompt the lay;
> Then rise those crags, that mountain tower
> Which charm'd my fancy's wakening hour."

The subject is one that might with advantage be pursued further; but not in this place.

There are certain characters which are not improved by the discipline of sickness, but under it become querulous, self-centered, and morose. Always some porcelain cracks in the furnace. But such people are in a minority, and very few come out of the sick-room with their outlook on life completely unaltered. A man who has never been ill before and who is suddenly caught in the toils tends at first to resent this forcible inter-

ruption of his activities; but gradually he learns to be patient, and his heart is touched with a new sympathy for others less fortunate than himself to whose lot more sickness falls. The understanding begotten of personal experience quickens his mind to pity. The appeal of weakness and helplessness is to him ever afterwards clamant and insistent. He can no longer shut his ears and harden his heart. He, too, has tasted of the waters of Marah, and found them bitter.

But, however much may be gained by the sufferer from the discipline of a single illness, it is in the gray ranks of that large fraternity who are the victims of chronic or incurable ailments that we best see how good may come of evil. There can be few things harder to bear than the dawning knowledge coming to a man or woman in the mid-time of their activities that, for them, participation in the battle of life is over, and that henceforth they can be nothing more than spectators. When the first storm of rebellion has died down in their hearts they discover that, though they are withdrawn from the general fray, they have a battle all their own to fight. And it is a battle that requires patience as well as fortitude — high spirit and self-sacrifice.

The world heaps its honors and rewards, and rightly, upon some of those who, amid the clang of arms and the roar of guns, do deeds of superb heroism. But there are no rewards, except the love and admiration of their friends, for those who fight a stern battle with themselves in the arena of their sick-room; and the heroism needed to brace a man for this silent conflict is often greater than that demanded on the battle-field. At first there may be a tendency to self-pity, but by and by this pity dissolves into a wider compassion that encompasses all suffering folk. At first the spirit chafes against the enforced inaction of the body and its sepa-

ration from so many of the things in which it took delight. But soon new avenues of enjoyment open before the wondering eyes, and the impotent man discovers that the world in which he had lived was only a small corner of the Universe — all of which is ready to minister to his solace. Through his window, in the dark and sleepless nights, he can catch glimpses of the stars — those eternal, silent witnesses of man's battle upon the earth. He can watch the diamonded belt of Orion; see fresh beauties in every wreath of cloud-wrack driven across the sky; watch, night by night, expectantly, the moon grow from a silver sickle to a great and brilliant orb, and find, as many a skin-clad shepherd in Palestine found in the childhood of the world, "The heavens declare the glory of God."

Then little simple things come to him with a fresh appeal. He watches the birds; they may become to him, as to St. Francis, his little brothers. He looks eagerly to see the first wave of cherry-blossom break in spray upon the branches, and, having found it, he will point it out delightedly to his next visitor. And when nature fails him he can turn to the world of books. He reads old favorites over again with a new zest, and finds in them subtle beauties hitherto undiscovered. That old ode of Horace, that poem of Browning, that novel of Scott, that essay of Ruskin, that letter of Stevenson, all glow with a fresh allurement; he never found such treasure in them before. And then there are the visits of his friends, each bringing his little trophy of news from the market-place — his little shred of kindly gossip — his good story, his helpful handgrip. Somehow all has changed. There are delights in life he had never dreamed of — joys, whose full savor he had never before tasted. And yet nothing has changed but the man himself: for, as Thackeray said, "The world is a look-

ing-glass, and gives back to every man the reflection of his own face."

So, out of the turmoil and fret of his soul, there springs a great contentment, and the courage to look with brave and undaunted eyes forward along the road of life.

One sometimes hears it said of this or that doctor that he carries into a sick-room a message of good cheer and hope, and it is given to some men to radiate from their personality an influence which sometimes does more good to the patient than the prescription — of doubtful Latinity — that they leave behind them. But we rarely hear of the influence of the patient upon the physician. Yet there are few who will deny that they have sometimes brought more out of a sick-room than they ever took into it. It is a sanctuary wherein they have communed with a great soul, they have been illumined by some of its radiance, they have caught a glimpse of " the light that never was on sea or land."

There are some sick-rooms that should always be entered with feet unshod.

That suffering can teach lessons in high altruism is obvious from the records of many a casualty clearing station at no great distance behind the front line. It is there that the terribly wounded first have the opportunity of receiving adequate surgical aid; and it is there that many a man has had the opportunity, and leaped to meet it, of putting into practice one lesson his own sickness had taught him — the lesson of divine compassion. Sometimes when a patient reaches one of these stations he has lost so much blood that there is barely enough in his body to keep the vital spark aflame. In such a case it is the custom to perform an operation called transfusion, and to introduce into his almost empty vessels a quantity of fresh blood from another in-

dividual. Sometimes a nurse or a doctor is the giver of blood; but more often, when the call for a volunteer is made, another soldier, now convalescent from his injuries, willingly makes the sacrifice. It is not a specially dangerous thing to do, nor is it, as the Army reckons things, a great thing to do; but it has in it the elements of nobility, and it is part of the nobility stamped upon the common clay of humanity by the discipline of sickness, and the lesson of compassion for all in like case learned by one who himself has known weakness almost unto death. The spirit of Sir Philip Sidney is not yet dead. You may find it in a lad from the slums.

In the aftermath of war we shall have to reckon with a harvest gathered by the sick and wounded from the discipline of their pain. That the discipline has wrought and is working its effects is sufficiently apparent to any one with the eyes to see who has been privileged, in however small a way, to minister to these stricken men.

It is unfortunate that none of those statesmen whose policy sometimes precipitates war, and who hold in their hands the destinies of nations and the lives of men, ever visit the wards of a war hospital at night. When they do come, they make their visits by day, and, as a rule, see things under exceptional and to some extent artificial circumstances. They see the wounded and sick smiling, cheerful, and happy. Their one desire, according to the press correspondent who expands upon the visit and, incidentally, upon the glories of war and the heroism of the men, is to get well, in order to have another shot at the enemy. Other things besides gun-positions may be camouflaged. But let them come at night, unexpectedly and unannounced, and by the light of a hurricane lamp carried by the sister — for, thank God, the lady with the lamp is still walking through the

aisles of pain — pass quietly from bed to bed. Some of the men are asleep. Others are awake, staring with open eyes at the bellying roof of the tent above them. Sometimes they cannot sleep for pain. That can be alleviated. Sometimes, if you ask them, they will say that they are all right, and are only thinking. These eager, wakeful, watching eyes haunt one. What are they thinking of? I fancy I know. Are they thinking of death? Not once in a thousand cases. They have looked that grim monarch in the face without flinching; they have companied with him in the trenches, and have ceased to fear him. Are they thinking of their loved ones? Yes: very often, and very tenderly. But most frequently, I believe, the burden of their thoughts is the appalling hideousness of war. Through their wounds or their sickness they have escaped for a time from the hell in which they had been living; but the memory of it — its sordidness, its grossness, its brutality — is still quivering in their minds. They rarely speak of things, but they often recall them; they cannot blot them out of their memory, and the thoughts persist in coming back in the still watches.

While they were living through their experiences they had not the time to reflect. But now they have time and opportunity, and thought will have its way.

And who are these men? Not uneducated and uncultured denizens of the slums, but the pick and flower of British manhood, representatives of every creed and of all classes. The son of the landed proprietor may be in the next bed to the clerk from the city bank; the university graduate is side by side with the porter from the warehouse; the poet and visionary is a near neighbor to the casual laborer; and all, each according to the measure of his capacity, is thinking, thinking, thinking, and storing up his conclusions to be the fount of ac-

tion some day in the future. They have seen, they know, they remember the utter hideousness of war, and they recognize its criminal stupidity, its insensate blindness. They recall how, before the cataclysm, the demagogue from his cheap platform, the brilliant journalist in his leading articles, aye, even the preacher in his pulpit, could dilate upon the glories of war; how war was a test of endurance, a toughener of moral fiber, a school for heroes, a nursery of self-sacrifice — as though these graces of character could not be engendered, could not flourish in some more gentle atmosphere!

They are weighing the good against the evil. They are seeing the shattered homes in Flanders and on the plains of Northern Italy; the pathetic, hopeless retreat of old men and women whose little cottages are in ruins; they are hearing the cries of ravished women and the forlorn wail of lost and terrified little children. They are remembering the blood and filth, the death, the mutilation, the irreparable destruction of useful human lives; men blinded, men driven mad, men blown to pieces, men maimed for all the rest of their days. And when, in the dead of night, the stretcher-bearers quietly enter the ward, and from a bed, hidden by the kindly shelter of two screens, lift a lifeless burden — somebody's boy, some woman's loved one — and, covering it reverently with the flag, bear it silently down the alley-way and through the canvas door, they turn their sleepless heads upon their pillows, and in their hearts salute the undying dead. The balance moves, and the scale on the side of evil touches the ground.

These silent, sleepless, thinking men are the bloodless revolutionaries of to-morrow. It is they who will, when the war is over, establish permanent peace upon the earth. They will see to it that never again in their

time or the time of their children's children shall international quarrels be put to the harsh arbitrament of the sword. It is good to defend a righteous cause, and to die for the right, if need be; but it ought to be made an impossibility for any autocrat, or any blood-intoxicated nation, sedulously to plot such evil that innocent men must die to reëstablish right. Tyrannies and despotisms must cease; and in days to come these wakeful, silent thinkers will be the chief agents in bringing about those larger conceptions of humanity and international brotherhood that will make war an impossibility. They will be coadjutors with God in winning out of catastrophe the fruits of moral order and moral progress.

CHAPTER XIII

LOVE AND MARRIAGE

"'Guess now who holds thee?'— 'Death,' I said, but there
The silver answer rang— 'Not Death, but Love.'"

E. B. Browning. *Sonnets from the Portuguese.*

"The soul's armor is never well set to the heart unless a woman's hand has braced it; and it is only when she braces it loosely that the honor of manhood fails."

Ruskin. *Sesame and Lilies.*

Let it be said at once, and frankly — the basis of all love between a man and a woman is, unless it be filial or parental love, sex-instinct. Fortunately, however, though it is imbedded in this elementary instinct, the passion may be so sublimed by imagination, and by the atmosphere of romance and idealism which it engenders, that its sexual origin is lost sight of. It may be, and often is, the motive power which lifts a man or a woman from baseness to nobility. It is one of the mightiest forces in molding character, and without it, and all that it connotes, society would tend to crash headlong into anarchy. Under heaven there is nothing holier or higher than true human love. It illumines the darkest corners of life, and transmutes the commonplace into the divine.

There is a fundamental difference between the love of a man and the love of a woman. In nature the male is the aggressor, ready to fight and vanquish all rivals. Among primitive men, before civilization had fashioned their conduct, the same principle held good, and a man fought for or stole his bride.

The mollifying influence of time and culture has made it unnecessary, except among savage peoples, to have recourse to such brutal expedients; but, in the way of love, a man still shows evidences of traits derived from a long-forgotten and vanished ancestry. Under the influence of the subtle passion his personality becomes more dominant. He lives on the tip-toe of his being. His finer qualities surge up from hidden depths. His mind is quickened. Consciously or unconsciously he seeks to make a good impression on the object of his love. He is seized by an intense desire so to impress his personality upon her mind that she may think of no one but himself. He can brook no rival. This is the feverish stage of love in which his remote ancestor, primitive man, would have sharpened his arrows. His modern successor instead takes to writing verses. Later, when he finds that his overtures are not altogether unacceptable, he develops other traits. He begins to deny himself — to think out little artifices of kindness that may give pleasure to the woman he loves. He foresees and forestalls her wishes. He tries to alter his habits of life in accordance with her desires, expressed or only guessed at. And all the while he is tortured by a longing to possess her; to merge his life with hers, to have a common existence.

By tradition and upbringing the love that first dawns in a young woman's heart is a thing to be kept secret. She must not be so unmaidenly as to seek her loved one. She must wait until he declares himself; whereon hangs one of the great tragedies of the life of womankind. But there are ways and means, and love is a clever preceptor. At first she tends to become reserved and somewhat self-centered. She is, through atavism, the bride to be, waiting for the result of the conflict of which she is at once the prize and the spec-

tator. She nurses her secret thought in her heart, until gradually it asserts itself and vibrates through all her being. Her eyes gleam with a new light. There is a fresh spring in her step, and if she finds — as lovers can — that she is loved by the man she adores, she enters upon a new cycle of life. Her whole world assumes a new value. She lives in an atmosphere of dreams. She is uplifted with a great pride, shot through with a tender humility, that this miracle of love should have come to her. She is possessed by the image of her beloved. The tones of his voice, his every gesture — the visual memory of his features, his personality fills her mind and there is no room for another. She clothes her lover with lofty attributes, and it is perhaps well for man that every woman in love is an idealist, for she sees him not as he really is, a very ordinary human creature, at the best made of common clay, but as something a " little lower than the angels," made beautiful in body and soul by her imagination.

Now that woman has received her emancipation, and has been made a participator in many of those activities of life that were too long regarded as the prerogative by divine right of man, there is less of the old atavistic relation in the matter of love, of aggressive, combative, and conquering male, and shrinking, captive woman. A woman now meets her lover on more equal terms. He is no longer the potential houselord, and she the subservient kneader of dough. Only a weak man, uncertain of his own authority, wishes to dominate woman. Only a soul-less woman places herself under the heel of a man. Men and women of character respect each other, and respect is no hinderer of love. Nowadays a man and woman meet as two human beings, complementary to each other, neither of whom can without the other fulfill their destiny. But romance is not yet dead, and

love still rules and guides their hearts to seek each other. And, having found each other, a man and woman in love are seized with a great desire; — a longing for the permanent continuance of the wonderful passion that has already drawn them together. They hunger for the blending of their individual lives into a common whole; they long for the opportunity of sharing together whatever of good or ill life may have to offer; they are consumed by a desire to be mutually helpful to each other — he to shelter her, she to succor and solace him when the storms of life buffet him. For, though it is rooted in sex-instinct, love is a thing of high moral value, and teaches lessons of loyalty, of self-sacrifice, and of spiritual fellowship. Where it does not kindle such aspirations it is not the divine flame, but some rushlight imitation which soon dies down. But where it is the fire from heaven it burns through all obstacles, and cannot be beaten back until love consummates itself in union.

The happiest marriages are those in which there is a slight temperamental difference between the contracting parties, but a strong community of interest. The difference in temperament should not be great enough to be capable of growing into an antagonism, and the community of interest should be one in which there is no identity of achievement, or overlapping of talent, but rather a complementary contribution from the one to the other to make a perfect whole. For an ideal marriage a spiritual affinity is a primary necessity; and that wedded life may be a success a large understanding and an immeasurable sympathy are indispensable. The absence of these qualities in a man or woman who have pledged their troth to each other may lead to disaster. The first year of married life is prob-

ably the most difficult. It is like a mine-strewn sea that requires skillful navigation.

The first shock of wonder at an unexpected revelation of character may lead to a pitiful estrangement, unless love is ever ready to forgive.

At first, in a happy marriage, the lovers are all in all to each other. Their happiness is complete in itself. Their joy is a golden chalice filled with rich wine which they drink together. They live in two worlds: one in which other people are permitted to exist, and the other, a little hallowed sanctuary of their own, where none but they can enter.

But gradually, when the fiercer glow of passion has died down into a steady fire, they begin to recognize that love has large responsibilities. They discover that their common life, which they have looked upon as such a perfect thing, is capable of even loftier perfection. A little dream hand knocks at the door of the woman's heart. It is the hour of her annunciation — it is the moment for which the great Giver of Life has prepared her, fashioned her as a woman, and dowered her with those qualities of mind and body that attract love, and which have won her a mate. The sex-instinct becomes the mother-instinct, and she is consumed with a great desire to bear a child. This is to be the pledge and token of her love for her husband; something very precious, the possession of neither, yet belonging to them both.

The mother-instinct is one of the most beautiful attributes of a woman's character. It is the possession of all normally constituted women, though in many cases, except in so far as it exhibits itself in solicitude for her husband, it may lie dormant for a long period after marriage. Behind everything, even though a

woman may be perfectly unconscious of it, it is the spiritually directed motive force that has caused her to love. Though it is latent in all women, it is in some keenly alive from the time they grow to maturity. Such women often choose a mate not because they are carried off their feet by love for him, but because they recognize that a husband is an unfortunate necessity to enable them to realize their desires. They are, all the while, looking beyond him to their unborn children. The marriage of a man and woman where this ambition has been the alluring force upon her side is quite capable of being, and frequently continues to be, a very happy one. For many a man and woman have been drawn closely together, even when they were beginning to drift apart, by the all-compelling strength of a little child — infinitely weak, but invincibly strong.

Purely from the biological point of view, the goal of love and the aim of marriage is the production of children. But, rightly interpreted, the purpose cannot be narrowed into such straitened limits. The begetting of children entails other obligations, both to the children and to society. It is the duty of parents to feed, clothe, protect, educate, guide, and instruct their children alike by example and precept in such a way that they may be able to rise to the full heritage of their humanity, and take their part as thinking, capable and reasonable beings in the material and mental life of the world. A recognition of these facts is the basis of that social and religious institution, the family. Certain people, who desire to put into practice the principles of a selfish individualism, hold that marriage should be nothing more than a matter of mutual consent between the contracting parties, in which everything is to be subordinated to the pleasure or convenience of themselves; the union to be broken at will, when the fires of the pas-

sion they wrongly call love have burned down. Such a system is anti-social, and is based upon a narrow egoism. To put it into practice would be to degrade human love from a high sacrament to the relations of the beasts in a stable.

Wholesome family life is a buttress of social morality, and it is well that the appealing helplessness of a child at birth, which unlike so many other young animals, can take no care of itself for many months, makes an irresistible claim on the affection of both its parents.

The love they had for each other assumes a deeper quality, and is enriched by this new possession in which their affections meet and blend. If there were no love of parents for their children, and they neither trained them in the kindly atmosphere of the family, or, through the aid of other people better versed in the education of the young, but cast them out at the earliest possible moment to fend for themselves, each child would be compelled to fight its own battle with nature — to live through once more, the conflicts of primitive man, denied all access to the accumulated experience of the centuries — driven to climb, with bleeding feet, a few steps up the hill of progress, and baffled, fall back again. As we have already seen, man is distinguished from the lower animals by the power of making use of the knowledge gathered by his ancestors. That is one of the secrets of his progress, and parental love and the institution of family life ensure that every child born with intelligence shall have the opportunity of benefiting by this great heritage.

As life moves on, and other children come, the parents find each succeeding child a fresh stimulus to their mutual affection. They may be unable to catch again the glorious rapture that came to them with their firstborn, but the memory of it stirs within them. Love

has lost its passion; that fine flame dies down ultimately, when nature has no longer need of it, but its place is taken by a sense of loyal and dependent companionship, colored by affection, which lasts till death breaks the union, and which may, indeed, overstep the grave. As they grow older the love of a man and a woman takes on a new quality, and in the case of a woman, if she is a mother, partly changes its direction. Her affection for her husband tends to sink a little into the background, though it is ready to leap forward again in the hour of his need. A great share of her love is now concentrated upon her children. They are his as well as hers, and in turning the full blaze of her affection upon them she is unaware that he is now relegated to a subordinate place. She sees him through them. If the matter were submitted to her she would probably deny it with passion and surprise, but the fact is obvious to any careful observer of human nature.

The goal of love is the continuation of the race. That is the end toward which all human passion was intended to move. It is only when man blinds himself to the elementary fact that the consummation of love is divorced from its legitimate purposes, and made to minister to selfish enjoyment. It is a wonderful provision that the strongest passion that humanity possesses, through which and by which men and women are called upon to fulfill their destiny and hand on the torch of life which has been passed down to them through countless generations, should be associated with all the loftiest attributes of mind and all the finer qualities of emotion. It is thus hedged about in order that its appeal may be universal; that it may not fail of fulfillment alike among those in whom the carnal appetites are strong, and those of finer fiber in whom the psychic qualities of love burn with a white flame which

blinds them to that other side that otherwise might repel them.

So far we have dealt only with love that has found its fulfillment in union. We must, however, recognize that there are lovers of both sexes to whom, for one reason or another, that consummation is denied. Death may have intervened, or some other insuperable obstacle may have made marriage an impossibility. It is remarkable that, though more male than female children are born, by the time adolescence is reached the disparity is on the other side and there are more women than men. It is within the bounds of possibility for every man to find a mate; but this happiness is denied to many million women, unless they are prepared to share the affection of the same man with some other woman. Polygamy may offer a solution among the semi-civilized, but it will never appeal to an educated and refined woman.

The disparity in the relative proportion of the sexes, which has always existed, will be sharply accentuated by the war, which has destroyed so many of our finest young men. And it is a pathetic fact, though only a small part of the harvest of suffering which the war has brought to women, that a large number of the girls of this generation, well qualified by health, by character, and by instinct to be the mothers of men, will forever be denied that ineffable joy. I never see a little wooden cross, with its simple inscription, and its heart-piercing "aged 22" without wondering whether beneath it lies a face that to some solitary, heart-broken girl was the face of an angel.

Love unfulfilled, or love incapable of fulfillment, becomes love repressed; and love repressed may have strange consequences. In the case of a man love repressed may endure for a long time until the obstacles that hindered its fulfillment can be overcome, and love

can have its way. But more often it fails to stand the corroding test of time, and declines until it becomes nothing more to him than a pleasant memory to be turned over in his mind now and then, and dismissed with a shrug of the shoulders. It does not usually produce any change in his character except, perhaps, to make him cynical. But, in a woman, love repressed or denied the opportunity of fulfilling itself may have a profound effect upon her character.

It may cause her to throw her energies into a crusade; to become the champion of the rights of her sex, and to direct her physical and mental energies into well-intentioned channels, sometimes with misguided zeal. It must be a matter of satisfaction to all right-thinking men that woman has now got the vote. She has earned that privilege nobly. But every physician knows that, to some extent, the rabble of riotous women, clamoring for their rights, which a few years ago made our city streets the by-word and laughing-stock of Europe was recruited from women suffering under the disparity in the relative proportion of the sexes, and the consequent repression of that sex-instinct which underlies human love. And I have sometimes thought that the wild displays of unwomanly violence, which stalwart policemen could not control, would have died down at the touch of the clinging arms of a little child, or the pressure of an infant's warm lips upon the breast.

Be that as it may, the problem of the woman doomed to an obligatory spinsterhood is likely to occupy considerable attention after the war. Many of these women, as they have done in times past, will spend themselves nobly in the service of others, and will find in the care and love they can lavish upon sick and crippled children in hospitals, homes, and institutions an outlet for the divine mother-feeling that, under happier cir-

cumstances, they would pour out upon their own little ones. Others will find occupation in the arena of business life. The war has opened up many avenues filled with new activities for women, and in these channels they will expend the energies that otherwise might have been employed in the rearing of a family. Some anæmic shadow of the love they could have bestowed upon a husband they will devote to their work; but even the most prosaic among them will sometimes think of what might have been, and occasionally turn over the fragrant rose-leaves of old memories with a sigh that woman's crown of glory has been denied them.

The opinion has been advanced — not boldly and openly as yet, though that may come — that it should be regarded as the inalienable right of every woman, married or unmarried, to have one child of her own. This is a plausible but most dangerous doctrine. It is dangerous because it fails to recognize the rights of the unborn child. The law might be persuaded to remove its "birth's invidious bar," but the child would be denied what it has the moral right to have, the sacred influence of family life and the possession of two recognized parents equally responsible for its upbringing and guidance.

If such a proposal is ever made seriously, and is regarded as coming within the sphere of practical politics, it will be met with fierce opposition. The strongest opposition will come, not from men, but from women, married and unmarried. By instinct and heredity women are idealists. They are ruled by the "emotion of the ideal." Their social instinct is a surer and a higher thing than man's. The mother-heart in them teaches them to look rather to the welfare of the race than to their own individual happiness.

With vision alert and clear they would see the worm

in the fruit, and would scornfully reject this proffered boon if it meant that their child was to be denied the privileges and amenities of a home such as children born in wedlock would enjoy. The home is the nursery of moral worth, and a perfect home implies the coöperation of two parents. Woman would see, with her marvelous intuitive gift, that this social experiment would, in its ultimate issue, be anti-social, and, as always, she would decide to sacrifice herself, and her innate desire for motherhood, rather than let the race suffer. It is to woman that we owe the institution of the family. On foundations laid by her the whole superstructure of social life has been established. She saw the vision, and toiled to make her vision a reality. Not lightly will she raise an impious and destructive hand to tear down the fabric she has striven to build, and has consecrated with her suffering and tears.

Love is of God. It softens the asperities of life; it makes life possible, and ensures its continuance and protection. And though it is, at bottom, intimately though unrecognizedly bound up with a selfish desire for the physical continuance of one's own being, it is the attribute of life which makes the greatest demand upon the spirit of self-sacrifice and self-abnegation. It is like a lily in the marsh. Its roots are in the mire, its pure face is turned up to heaven. The great Architect of the Universe might have chosen some other means than the fruition of love to ensure the continuance of human life upon the earth. But so it has been decreed; and we frail creatures of the dust have reason to be thankful that the mystery of life is so bound up with the high sacrament of love.

CHAPTER XIV

WORK

"Man hath his daily work of body or mind
Appointed, which declares his dignity,
And the regard of Heaven on all his ways;
While other animals inactive range."

MILTON. *Paradise Lost.*

MAN is by nature a creature of inertia, but of necessity an energetic animal — he works. There are advocates of the mechanical theory of life who regard the human body as nothing more than a great and complex power-station for the conversion of one form of energy into another, and for its direction into new channels. Just as a fire cannot burn without fuel, which it reduces to smoke, ashes and heat, so no muscle can contract, no limb move, no organ of the body discharge its function without the coincident destruction of some portion of organic material.

In its destruction this organic material is reduced from complex to simpler forms, and in its descent liberates the energy which was potential within it. In order that the equilibrium of the organism may be preserved, the material reserve of this potential energy must be restored. It is made up by food, by water, and from the oxygen of the air. Before these constituents can be built up into the reserve-stuff of energy they must undergo modifications in the digestive and circulatory systems. When properly modified they are incorporated in the reserve-stuff of the organ which needs them, be it liver, or heart, or muscle. They become an

integral part of the living tissue through which ultimately their energy will express itself. The potential chemical energy in the reserve-stuff of the tissues may differ remarkably from that contained in the original food-stuff. This building up and storing of reserves of energy was called by Claude Bernard "Synthetic Organization."

"The organizing synthesis," he says, "remains internal, silent, hidden in its phenomenal expression, gathering noiselessly together the materials which will be expended."

The wonderful cycle of phenomena in the genesis of clouds and the fall of rain is a matter of common knowledge. The sequence has already been described in these pages: from sea to cloud; from cloud through dew or rain back to the sea once more. But there is another succession of phenomena equally wonderful, but much less known, in which the sun also plays the master part. The plant kingdom is the great builder up of energy, which is liberated in the form of work by the members of the animal kingdom. Through the magic influence of the sun the chlorophyll of plants can break up the carbonic-acid present in the atmosphere, and store up the carbon in their tissues. They can convert the inorganic into the organic. No animal is able to do this, and in this respect a man is less highly endowed than a blade of grass. Without the vegetable kingdom animal life would be impossible. All animals, man included, feed directly or indirectly upon the carbon-containing compounds elaborated by the plant kingdom under the influence of the sun. And it is through the animal kingdom that the energy derived from the sun, and stored up by the vegetable kingdom, is returned again to the cosmos. Part of the energy is given back in the heat generated by bodily activity; part is consumed in work

done. All work done can be expressed in terms of motion; heat is nothing more than a mode of motion; and we must not forget that solar energy comes to us as an undulatory motion in the ether. These facts, which have been determined scientifically, demonstrate the intimate harmony and inter-dependence that exist between the different parts of the Universe. When we remember that only an infinitesimal fraction of the total energy of the sun reaches our earth — the actual figure is $\frac{1}{2070650000}$th part of its light and heat — we may well wonder what undiscovered potentialities lie hidden in the remainder; and we can understand that it is no mere empty superstition which has made some men, in all ages, worship the sun as the giver of life.

The elementary needs of man were probably the first motives that drove him to work. These elementary needs are still clamant, and with some men are the sole impulses that drive them to exert themselves. Man early discovered that food for himself and his dependents, clothing to protect them from the changes of the weather, and a roof of some sort to cover them, could only be secured by work. When man first appeared upon the earth it is probable that he found ample food within easy reach. But later, as the number of men upon the earth increased, the available supplies of food would become less easy of access, and man would become a hunter. Hunting, which is now a sport, was in those days a form of labor, but withal a form of labor rendered attractive by the element of hazard it contained. From the beginning man has been a tiller of the ground. He would soon discover that, by cultivation, he could increase the available quantity of the fruits of the earth. Probably, at quite an early stage in his existence, he took steps to grow in a little allotment which he staked

out round his dwelling those plants and herbs which he had discovered would sustain him. So, by laboring he lessened his labors. He no longer needed to forage far afield for vegetable food. With a little prescient work he could make it spring up at his own door. In exhibiting this quality of careful prevision man distinguishes himself from other animals. We have already seen that certain members of the animal kingdom lay up stores of food, but no animal other than man by labor prepares the ground, transfers to that ground plants or seeds which he may have found at a distance, and tends, by watering and dressing, his young crops, and waits for the fruits of his labor to supply him with nourishment. Such work displays intelligence. Bees and squirrels are food-hoarders by instinct, which is just a habit repeated through a long series of generations until it becomes transmitted by heredity. Man is a cultivator of the ground, a laborer on the earth, and a hoarder of food, because his intelligence gives him prevision.

The second demand that drove man to labor was the need of a covering to protect himself. Less well furnished with a hairy covering than his nearest animal relatives, he would be more likely to suffer inconvenience from changes of weather. Leaves and skins fastened loosely round him were probably his earliest protection, and then on a wonderful day either he or the woman who was his mate invented a needle. Probably it was nothing more than a sharpened piece of bone, such as the Esquimaux use to-day, with which he could pierce the skins and lace them together with strands of vegetable or animal fiber. No animal lower in the scale than man has ever invented a tool so simple. Yet what simple instrument is so pregnant with possibilities as the needle? The first sharpened piece of bone driven through a hide by a primitive cave-dweller made pos-

sible the evolution of the whole world of dress, and laid the foundations of the *Rue de la Paix*.

The first men probably sheltered in caves of the earth, either found naturally, or excavated artificially by the labor of their hands. The next stage in the evolution of a dwelling-place was probably the tent, extemporized by stretching between the branches of a tree skins from animals killed in the day's chase by some hunter who, in the pursuit of his quarry, had wandered far afield from his cave and been overtaken by a storm. In process of time the tent, an easily transportable form of dwelling, would give place to a more elaborate structure of earth and wood and stone, gathered together with much effort, and erected with much thought and toil. This was the prototype of the modern dwelling.

At every stage man has made use of the accumulated experience derived from his own earlier endeavors and failures, or from those of others, to improve the work of his hands. In this he shows how the possession of intelligence, memory, and the power to design a plan and to work up to it place him head and shoulders in the field of labor above all other animals.

The birds, the bees, the mole, the beaver, are all older creatures than man. Yet, so far as is known every bird builds precisely the same kind of nest as its ancestors did at the beginning — or, if there are any changes, they are infinitesimal; the bee still constructs the same shape of cell; the mole is content with the gallery that satisfied his forefathers a million years ago, and the beaver has invented no tool to make his wood-cutting easier, and still builds the same kind of dam as his primeval forebears. But man is never content with the result of his work. He is ever eager to improve upon it; to discover new methods of performing it; to invent instruments and tools which will facilitate it.

These things he does because his labor is guilded by intelligence, and not by instinct. He has this great advantage over the lower creatures: his predecessors have put on record, at first by oral tradition, and later in writing, the means they employed to achieve certain ends, and these records are available for his study and instruction.

Were it not so, every man would, so far as his labor is concerned, be compelled to begin his struggle with the forces of nature at a point somewhat antecedent to the stone age, and start discovering everything for himself again.

It is a paradox that man, through his labor and inventiveness, has retarded in some measure the progress of his own evolution. The human hand is a very wonderful instrument, capable of remarkable adaptations, and of the finest coördinated movements, as is demonstrated by any skillful violinist or pianist. But man has hindered the further evolution of the powers of his hands by inventing tools and machinery. In the same way he has hindered or interfered with the higher evolution of the eye by the invention of magnifying glasses and the microscope. He has also limited, except in the case of a few trained athletes who have specially developed their powers of locomotion, his speed of movement by making use of animals such as the horse, or machines such as the bicycle, the train, and the motor-car, to convey him from place to place; and by the building of boats he has limited his capacity as a swimmer. Thus, by the use of his intelligence, and the products of his inventiveness and toil he has unwittingly put a brake upon his own physical evolution; but in doing so he has achieved what would have been impossible for him, however highly his structural and functional evolution might have progressed.

Once man had succeeded in supplying his primitive needs for food, shelter, and clothing, he advanced a stage, and became more or less of a specialist. As communities grew, certain duties would be delegated to certain individuals. The hewers of wood and drawers of water, the cultivators of the soil, and the house-builders would be recruited from among those of the tribe to whom the hazardous adventures of the chase made no appeal. And from these small beginnings there gradually grew up our present system whereby a workman chooses his occupation or his trade and devotes his activity to that, and to that alone.

When we analyze the work which engages so much of human activities, and push our inquiries down to root-principles, we discover that an enormous proportion of it consists of little more than the removal of matter from one part of the earth's surface, and its transference to another. In the process it may be subjected to the operations of intelligence, as when cotton grown in South America is brought to Lancashire, and woven into fabrics. But in all work, in which our physical rather than our mental functions play the chief part, we are little more than hod-carriers. But when we consider the arts we find that in his work man may become a creator. He hews a piece of marble into a beautiful statue, and thereby expresses an idea; or with brush and colors he paints a vision of his dreams. Or he erects a beautiful building, so exquisitely designed, so well-proportioned, and so perfect in every detail that it is a palace of art. This is creative work; and we find the same germ of creative activity in every newly-invented machine. So that though man's work begins on the level of the beasts of burden, it ends somewhere in the skies.

Man and society are so constituted that work is a

duty. It is a duty which man owes to himself and to humanity. To himself because happiness lies in the line of congenial work, and to humanity because it is incumbent upon every one to contribute something to the common welfare, and not to be a parasite.

This is an ugly word, and may have a sinister meaning. It has been applied by red-hot would-be demagogues to all who do not work with their hands. Such orators usually harangue their audiences with their own hands concealed behind their backs.

But the designation of work cannot legitimately be restricted to manual labor alone. The man who works with his brain is not a parasite, nor is the capitalist who imagines and plans and sinks his wealth in some great enterprise in which the actual labor is performed by other hands than his own. Parasites on human society are not many; and they are to be pitied, for they never know the joy of work.

A congenial occupation, in which a man has scope for the exhibition and development of his own character is, however hard the actual work may be, capable of affording him the highest pleasure. But the work must be suited to his capacity and such as he can take a pride in. The tilling of the ground is among the humblest, as it is the most ancient, of occupations. But what joy can be extracted from it by all who love a garden! It is a lesson in the infinite and soulful possibilities of the lowly task, to be shown round his garden by a gardener who loves every inch of soil in it; who knows the potentialities of that corner for the growth of roses; of that patch of light and sandy soil for his geraniums; and of that furrow for his potatoes. Such a man takes a pride in his task; he extracts joy from it; he ceases to be a laborer and becomes an artist, for love sanctifies and ennobles lowly things.

Any one who is unfortunate enough to be chained to an uncongenial occupation is to be pitied. If he has no love for the work he is engaged upon it becomes an intolerable burden, and, having become a burden, it tends to react upon his character, and make him slack, inattentive and careless. Occasionally he may extract some satisfaction from his unloved task if, by chance, one day he has performed it well. For all work, if done well, may produce a feeling akin to joy in the doer of it.

This is a truism which every school-boy can confirm. The biographies of eminent men afford us many examples of the torture of the uncongenial task. One need only recall Burns, and his work as a revenue officer. His soul was sometimes in the skies with the singing birds, while his nose and eyes were hunting for smuggled brandy and illicit stills. He was a great lyric poet; but, because he hated the task, a very indifferent gauger. The psychical distaste to an uncongenial task may react physiologically, and it has been proved by experimental observation that the same person will perform a greater amount of work in a given time when occupied on a task which may not necessarily be easy, but which is attractive, than upon a task of a similar kind for which he has no liking. Work unloved becomes drudgery, and drudgery is the task of slaves.

On physiological grounds it is necessary that periods of work should be interrupted by periods of repose. Even machinery, capable as it is of being driven at full pressure almost indefinitely until it wears out, runs better and lasts longer if it is granted occasional seasons of rest. And though the human mechanism is capable of carrying on its work in an emergency for a time much greater than usual, a point comes at which, through exhaustion, the tired body is unable to continue discharging energy any longer. The reserve-stuff of

energy is almost all used up; the muscles, and brain, and circulating blood are engorged with poisonous by-products, produced in the body by the consumption of the reserve-stuff, and until rest, and sleep, and food can be obtained, the body refuses to do any more work. During rest and sleep the poisonous by-products are collected and eliminated through various channels; and food supplies the organism with potential energy which, after digestion and assimilation, is stored up as chemical energy ready at need to be converted once more into work.

Long before the extreme stage of exhaustion above described is reached, fatigue of a lesser degree has existed. Before exhaustion is great enough to be actually felt by the worker it is sufficiently advanced to interfere with his work. Careful experiments have been carried out which serve to demonstrate this. It has been found for instance, that a worker engaged on a purely mechanical and frequently repeated operation can turn out a certain number of complete articles, in, let us say, a period of two consecutive hours; but if, at the end of forty-five minutes, he is allowed a rest of a quarter of an hour, he will turn out a larger number of the completed articles in the second forty-five minutes than he did in the second hour, and this, although at the end of the two consecutive hours of work he was unaware of any sensation of fatigue.

It is therefore evident that fatigue is an insidious thing, and begins much earlier than its sensation appears. But it may be recovered from rapidly if suitable periods of rest are allowed. In many of our munition factories careful studies are being made regarding work and fatigue, and when the observations are duly collated and examined it will be possible to make large deductions, of wide practical import, which, if ap-

plied, will make for a revolution in labor conditions, and for the increased efficiency and happiness of the workers. There is a very fine adjustment between the nervous system and the muscular system. It is something more than a mere " afferent stimulus — efferent impulse " sequence. There is a psychic element, as that commanding officer well knew who got the last ounce of effort out of his wearied soldiers by means of a tin whistle. Men or women who sing at their work usually increase rather than diminish their activity, for emotion or memory stirred by song brings the higher psychic realm into more intimate touch with the lower psychic realm, and together they hasten the discharge of nervous energy to the expectant muscles.

It is frequently said that change of occupation is rest. The aphorism embodies only a half-truth. Like all general statements of the kind, it requires some qualification. If carried too far it may prove to be a dangerous doctrine. It will at once be understood that to change from one form of activity to another, in which the same group of muscles is involved, is not rest. A soldier, who is fatigued by trench-digging, would not look upon a change of occupation, to the somewhat lighter task of a route-march, as much relaxation. Nor would it be, as many of the muscles called into play are the same. But a complete change of activity, a change, let us say, from the use of the muscles to the work of the brain, is a rest of a kind.

When Mr. Gladstone turned, as was his wont, from the political conflicts in which he was embroiled, to writing articles on theological subjects, or to the study of Homer, he was indulging in a change of occupation. But he was using much the same faculties in both pursuits. When, however, he abandoned his study for the woods and took to felling trees he was giving his in-

tellect a complete rest. But, whatever his occupation, he was using up some of the " reserve-stuff " of energy, and in doing so was producing in his system toxic by-products, the smoke and ashes of all work, which required to be eliminated from the system. So that though one set of organs might be given a rest by his employment of another set, those organs of the body which have to do with elimination were kept working at high pressure all the while. In the course of their functional activity these organs also use up the reserve-stuff of energy, and consume nervous energy as well, so it is obvious that there are better ways of resting than to change the kind or direction of one's activities.

Every man should have a hobby, and his hobby should be chosen with care. It should, as far as possible, be some form of activity separated by a wide gap from his ordinary occupation. For instance, a clergyman should not choose reading as his hobby; he would be better occupied with golf. That a hobby may be of greatest value to its devotee it should take him into a new atmosphere, mental, and, if possible, physical as well. It should never exhaust him, nor should it be such as will deflect all his love from his ordinary work. Rather should it send him back to his daily occupation with faculties brightened, enthusiasm kindled, and his whole being refreshed. If it does none of these things a hobby becomes a hindrance instead of a help, and should be given up.

" The dignity of labor " is a catch-word that is frequently employed, and the phrase embodies a great truth which has not yet adequately been appreciated. For what is labor? It is the expenditure of energy. We have already seen that all the energy incorporated in the living organism is derived from the sun. The plant gathers it — the animal kingdom expends it.

To man is given the right and the power of spending what portion of this wealth comes to him, with intelligence. Through him it returns to the cosmos. It is therefore his duty to guard against degrading this energy, or dissipating it too prodigally upon unworthy ends. Some degradation and some dissipation of energy it is impossible to avoid; but if man will only realize that in using energy, which he cannot create, he is holding a trust for the Universe, his work, whatever it may be, will assume a dignity that it lacked before. Looked at in this way, which is physically and physiologically the right way, the humblest task is clothed with new responsibilities. It becomes part of the great world-order, and honest work is sacrosanct.

This conception of work entails a readjustment of values. We come to recognize that the clergyman, the teacher, the writer, the poet, the man of law, and the physician are in a true sense as much laborers as the man who earns his living with pick and shovel. The clergyman, the teacher, the writer, and the poet each in his own way repays the world-order for his consumption of energy by his loyalty to the ideal. The loftier the ideals proclaimed to the world the more earnest becomes the purpose of those who mold their lives by them, and no man of serious purpose willingly shirks his task. Ideals make for the genuineness of work, and genuine work economizes the stores of cosmic energy.

The physician, by his work, justifies his consumption of world-energy by protecting and saving the lives of others, by making them efficient, by teaching them the way of health — and the healthiest man does the best work. The man of law makes conditions of work possible. So it is seen that all humanity is bound up in a great confederation of energy-users, engaged in the

common task of spending to the best advantage the wealth of solar power they have indirectly acquired from the giver of light. Take the laborer, the man at the bottom of the pyramid, out of it, and the structure collapses. Take out any body of men from the higher levels, and the efficiency of the others suffers. All are co-partners in a sacred trust.

If life did not offer the opportunity of work it would lose half its charm. Men would soon grow tired of sitting with folded hands, and the world would become a place of misery.

For work is a great source of happiness, and the bringer of measureless solace to mankind. The conditions of it occasionally give rise to sharp dissatisfaction, but congenial work done honestly and to the best of one's ability makes for contentment. And though a restless ambition is a great asset, a contented mind is immeasurable wealth. This is one of the rewards of him who works. Its price is above rubies, and it cannot be purchased with gold. All work has the power of bringing contentment to man; some work brings him joy. Work through which he can express his spirit is creative, and in so far as a man feels that he is, in the discharge of his task, a co-worker with the Infinite, he tastes of the cup of joy.

He is a poor creature whose only aim in work is his own sustenance and comfort, or the accumulation of wealth. He is false to the world-trust in which he shares. His work is worthiest who consciously or unconsciously does service to humanity, be he drain-layer, navvy, or lawgiver. The service of humanity should be the goal of all work. The civilization to which we are heirs is the fruit of age-long effort and much labor consecrated to lofty ideals. It is our duty to improve that heritage for those who are to follow us; to leave the

world a healthier, happier, cleaner, and more wholesome place than we found it — a place in which life will have fewer asperities and ampler opportunities. These things may be accomplished by work, if the aim of the worker is high.

Happy is the man who comes to his task each morning with a singing heart, and who has learned that the humblest worker becomes a mighty craftsman when his soul speaks through his labor. The honesty of workmanship is an acid-test of character. Alone, amid the eternal flux of things, the honest work endures; and if man had no other immortality to look to he might find one along the line of his daily duties.

CHAPTER XV

THE REVELATION OF GOD TO MAN: RELIGION

"There is nothing on earth that does not show either the wretchedness of man, or the mercy of God; either the weakness of man without God, or the strength of man with God."

BLAISE PASCAL. *Pensées.*

"All tended to mankind,
And, man produced, all has its end thus far:
But in completed man begins anew
A tendency to God."

BROWNING. *Paracelsus.*

LIFE without labor and without love would be incomplete; without religion it would be hopeless and desolate. Professor Drummond used to say that the special charm of Millet's picture "The Angelus" consisted in its combination and representation of these three attributes of human life: love, the man and the woman; labor, the hoe, the barrow, and the cultivated earth; and religion, the distant village spire, and the attitude of devotion of the figures, called into the presence of the Eternal by the sound of the evening bell. Together these things give life beauty, purpose, and solemnity. Rob life of one of them, and it suffers; rob it of all, and it becomes a pitiable derelict.

Religion is that part of a man's mental life which tries to envisage God, which stimulates him to seek to know the Power that rules the Universe, and to recognize therein a Spirit to whom he owes fealty and affection, and a Father whom he may dare to trust, to wor-

ship and to love. But a properly balanced religion should have another side: it should embrace both God and man.

A man's faith should teach him to love his fellowmen, and to have confidence in the future of humanity. Religion is the atmosphere of the soul, and the benevolent mother of character.

For some people the practice of their religion is nothing more than the punctilious observance of a code of good manners. To them duty is an obligation only in so far as it is socially expedient, and ideals mean no more than the society ambitions of their set. They have never felt the flame of a God-directed aspiration burn within them. A social *faux pas* troubles them more than a breach of the moral law, and the dread of social ostracism is more to them than the fear of eternal punishment.

Religion being the tie which binds man to the Highest, or the atmosphere of the soul within which he seeks to worship God, it is right that we should inquire how he first acquired his conception of the divine and became a theist. The mystery was revealed to him progressively, and at first along three natural channels. God is invariably Self-consistent, and made use of secondary channels for this revelation as for all other manifestations of His power. He chose to speak through the voices of Nature; to make use of man's affections, operating through his love and veneration for his dead; to sanctify conscience, converting it from a rudimentary tribal instinct into His witness in the soul.

Man had within him a capacity for understanding, and Nature spoke her message into his astonished ear. The whisper of the wind in the dark and forlorn aisles of the forest, the uncanny earth-voices audible in lonely places, the roar and thunder of the sea, the cataclysms

of Nature, the earthquake, the lightning and the thunder spoke with an awe-inspiring message to man. These things must be the manifestations of some Power mightier than himself; there must be invisible creatures — gods; spirits of evil power, spirits possibly beneficent. Some may be inclined to doubt that any revelation came through this lowly channel, but who among us has not heard the voice of Nature, which is a tone of the voice of God, speaking to us in the beauty of flowers, the lonely grandeur of mountain peaks, or the wizard music of the sea? We correct our impressions by the experience won from the fuller revelation in our souls. The primitive savage was not ready for that larger revelation, and did not fully understand, so the phenomena which should have taught him to love and worship taught him to fear as well. We cannot lightly dismiss the fact that in all ages the message of Nature has won its way into the heart of man. The philosophers, the theologians, the poets, and the artists consciously and unconsciously have interpreted that message as the voice of God. From the prophet Job and the psalmist David down to the present day men have recognized in the voices and beauty of Nature a witness to the Highest, and there are few to whom its appeal has not come with an insistent force, that was something more awe-compelling than mere emotion stirred by hearing or sight. More than any modern poet Wordsworth had a soul attuned to catch the whisper and the message of Nature's God-revealing harmonies. Who cannot say with him? —

> "I have felt
> A presence that disturbs me with the joy
> Of elevated thoughts; a sense sublime
> Of something far more deeply interfused,
> Whose dwelling is the light of setting suns,
> And the round ocean and the living air,
> And the blue sky, and in the mind of man:

A motion and a spirit, that impels
All thinking things, all objects of all thought,
And rolls through all things. Therefore am I still
A lover of the meadows and the woods,
And mountains; and of all that we behold
From this green earth; of all the mighty world
Of eye and ear,— both what they half create
And what perceive; well pleased to recognize
In nature, and the language of the sense,
The anchor of my purest thoughts, the nurse,
The guide, the guardian of my heart, and soul
Of all my moral being."

Another line along which revelation came was man's veneration for his dead. As early as the neolithic age he had begun to conclude that death did not mean annihilation, but that man after death went on to another existence where he had need of some of the things that had served him on earth. So there arose the custom of burying with the dead food for his journey into the land of the Immortals, and weapons and other objects which might be of use to him there. This was a long step forward, for the belief had in it the nucleus of all subsequent faith in the destiny of man; and under the influence of the teaching of Christ there evolved from this elementary conception the confident assurance that the souls of the righteous go home to God.

The third agent in this slowly unfolding revelation was conscience. Of recent years an attempt has been made to reduce conscience from its long-recognized position as the voice of the Universal Father within the heart of man, to a mere herd instinct or clan spirit. Possibly it may have arisen in some such form of loyalty. A man's conscience blamed him when he was guilty of any act that might work disaster upon or be prejudicial to a member of his own tribe, or approve of his action when he had done something from which the tribe or clan might derive advantage. But any one who reads history aright, and observes not only the social but moral

development of a people, must admit that the primitive characteristics or faculties of a people are capable of being sublimed into something much loftier than the elementary attributes from which they originated. Among civilized people the narrow clan spirit or tribal instinct has long ago died down. In one direction its place is taken by patriotism, which is a clan spirit that embraces one's own country. In another direction its place is taken by conscience — which no one would confuse with patriotism, as it operates in a field into which patriotism rarely obtrudes except in time of war.

Nowadays the promptings of conscience are no longer an atavistic trait, but the response of all that is best in man to the voice of the Eternal. What man is there who has not experienced the remorse of conscience? — and, knowing it, does not recognize in it something infinitely higher and more soul-searching than mere regret for disloyalty to his herd?

It is a matter of interest to note how Nature, which, as we have seen, is one of the agents of revelation, coöperates with and reinforces conscience, another agent.

The poets have emphasized this over and over again:

> "The thief doth fear each bush an officer";

and:

> "When the deed was done
> I heard among the solitary hills
> Low breathings coming after me, and sounds
> Of undistinguishable motion, steps
> Almost as silent as the turf they trod."

This is the eternal story: the forces of Nature are used to drive home a moral lesson.

Along these three channels, therefore, there came to man some revelation of God. He was unable to grasp the whole truth and his feet were prone to err, so that he wandered into the by-paths of superstition and su-

perstitious practice. In this he was aided by the thaumaturgists, or wonder-workers — men a little cleverer and a little less scrupulous than their fellows, who saw in man's gropings after God nothing of nobility, but simply an opportunity to establish their own prestige and give them ascendancy over their dupes. But, in spite of all human distortions and all human accretions fastened upon it, the stream of revelation held on its way.

The Jewish race has always been famous for its intellectual gifts, for its imagination, its intuition, and its receptivity. It has a peculiar genius for religion, so it is little to be wondered at that it first intercepted the full stream of the revelation and recognized it for what it was. It proclaimed with no uncertain voice that there is one God, and one God only. It brooked no minor deities. This unique people, gifted with extraordinary spiritual insight, had among it certain men of richer intellect and higher spirituality who were absolutely convinced that through the voices of Nature and in the secret chambers of their hearts they heard the voice of God speaking to them. They did not hesitate to declare their message, attributing it definitely to its source with the words, "And the Lord said": They were men attuned to the Infinite. A piano-wire tuned to the note of "C in alt," or to any other note, and stretched across a room, will vibrate in harmony when that note is struck upon a piano; and the mind of man in tune with the Divine Mind, will catch the whispers of God's voice to which other men are deaf.

Among the Jews, for the first time in human history, morality and religion were definitely linked together. In this, Judaism presents a most striking contrast to the pagan religions of ancient Greece and Rome. The Greeks and Romans were polytheists; their numerous

gods and goddesses were superhuman creatures with human passions and lusts abnormally exaggerated. They were gods without morals as we understand the term, and as a consequence the religion of their followers, except in a few cases, was completely divorced from morality. It is strange that a people so highly cultured as the ancient Greeks could have taken a delight in and worshiped such gods. But with some, like Socrates and Plato, the religion they practiced was infinitely higher than the gods they worshiped; and once and again a sculptor with a vision of the divine would try to capture his dream and imprison it in marble or in bronze, and in Greek art, Greek sculpture, Greek poetry, and Greek philosophy, rather than in Grecian mythology, we catch a glimpse of God.

Revelation was progressive, but it was infinitely slow; so slow that even a child might follow it. But even then, man with his inborn capacity for error was perpetually wandering off, as he still continues to do, into bypaths of unbelief. It is a proof of the confidence of the Eternal in His revelation that He chose to make it through natural channels rather than by the supernormal. He knew that men would come to the truth in time. He had endowed them with intelligence, the weapon which had helped them to establish their ascendancy in the animal world, and He was prepared to wait till, through the proper exercise of that gift in the interpretation of the evidence afforded them, they should at last grasp the secret. He knew His creatures; knew how they would err and stumble, but knew also that only that is immeasurably precious to man which he has won by struggle.

The consummation of the revelation to man came in the person of Jesus Christ. In Him we find at their loftiest and best all the highest qualities of humanity,

with none of the degrading elements of evil that are a part of the personality of ordinary men. He showed to what a height of perfection human nature might be raised. He was possessed of a dauntless courage, which faltered only once, and then but for a moment. His soul was aflame with a white-hot anger against evil wherever found; but this was tempered by a large charity that proceeded from a divine understanding and an infinite power of compassion.

He went about doing good; lived an absolutely blameless life; was able to resist the most subtle temptations; was betrayed by one of His disciples; was shamefully put to death by the Romans at the instigation of the Jews; was laid in the tomb, and rose on the third day from the dead, and ascended, as "the beloved physician," St. Luke, has put on record, from the summit of the Mount of Olives in a cloud into the infinite expanse of the heavens. He was born of a simple Syrian maid — the wife of a village carpenter; He claimed to be the Son of God.

Such, in briefest outline, is the story of the most remarkable Personality the world has ever known. The tale is so wonderful, and the mysteries associated with it are so great, that in all ages there have been men who have not hesitated to affirm that the whole thing is a myth; or that, if there ever was a man called Jesus, He was nothing more than a simple village lad suffering from delusions of grandeur.

A myth! An idle tradition! A delusion! No myth or delusion ever bore such rare fruit; no idle tradition was ever pregnant with such enduring realities. If the story were not true, or the claim a lie, it would long ago have been cast into the rubbish-heap, and have ceased to influence the lives of men. But to-day, after the lapse of nineteen hundred years, the influence of

Christ and His teachings is infinitely greater than it was at the time of His crucifixion.

He made no attempt to establish a kingdom by might. All He left to the world were a handful of simple doctrines; a little collection of parables; a few beatitudes, praising meekness, compassion, purity, and the peaceful spirit, promising comfort to the mourner, and offering hope to those ambitious for the good and the right; a simple but sacramental love-feast, and the priceless example of an immaculate life. He was poor; of lowly circumstances; no seeker after power; with no reputation in His life-time that extended beyond the confines of a little corner of Palestine; but He has conquered the world.

In their day and generation Alexander the Great, Julius Cæsar, and Napoleon Bonaparte were men of wide renown — conquerors who, by the might of the sword, trampled nations underfoot. To their contemporaries they must have seemed individuals of tremendous importance. But what influence has any one of them had upon the lives of the generation now living? In the eternal scale of truth it could be counter-balanced by a hair. But the life of this obscure and "deluded" Nazarene has altered the whole of history. It has done infinitely more than that: it has leavened all human thought, permeated all literature, all philosophy, all poetry, and touched with the beauty of holiness innumerable human lives, which, but for their devotion to His person, and their conformity to His example, would have been sordid and worthless. It has been the fount of all the loftiest ideals, and the source of an irrefragable hope. Such things do not flow from myths; they are the offspring of inscrutable mysteries.

One of the most remarkable features of Christianity is that it creates an atmosphere which influences even

those who profess no allegiance to the person of Christ. Every hospital in England, and every institution for the help of the distressed, is a perpetual witness to this fact.

Many philanthropists who make no profession of Christianity imagine that their charity is a product of civilized humanitarianism. But unconsciously they have been quickened to pity for their fellowmen by the spirit of social service which was first taught by Christ. Nowadays we hear much of the social gospel and the gospel of humanity. These are, in their way, excellent things; but they owe all that is in them of nobility and any gospel they embody to the life and work of the Crucified. He was the first socialist, and the first positivist. He taught the equality of man, and showed the heights to which human nature could be sublimed.

There is much in the life of Christ and His Death and Resurrection that is enveloped in mystery. But these are the mysteries of faith, and as we are ready to accept in the ordinary walks of existence so much that we can neither understand nor explain — such, for example, as the miracle of our own conscious life — it is illogical to reject, or shrink from accepting, because of their incomprehensibility, mysteries which have produced results so real and tangible. No ardent and practiced climber would think much of a mountain which did not present him with some difficult crags to scale, and some deep and abysmal crevasses to bridge before he could stand in amazed and ravished wonder on its summit. So it would seem that the enigmas of the Christian religion are set there to test our courage and our faith, and to make of life no colorless and uninspiring ramble along a level road, but a high and soul-testing adventure.

To be of service to a man his religion should be one

to which his intellect can give assent. This does not necessarily exclude that mystical quality without which no religion can exist, but it keeps it from drifting into superstition and superstitious practice. Nor does it exclude the miraculous. A miracle is something, surpassing reason, which happens or is wrought in apparent opposition to the recognized laws of Nature. We must recognize that the so-called laws of Nature are the lines along which God usually acts. The Maker of the law can suspend the operation of the law, and so work a miracle. It is sometimes said that the age of miracles is past. This may be so if we confine the miraculous to phenomena that are purely physical; but miracles are still being wrought daily in the secrecy of human hearts.

None but a bigot will deny that religion is a far bigger thing than churches and creeds. Most Churches lay claim to a special vested interest in God. How the Infinite must laugh at the arrogance and effrontery of His children! Some people imagine, indeed they have been taught, that He can best be worshiped within the confines of some building specially consecrated for the purpose. It is meet and orderly that there should be such places for worship — Christ Himself worshiped in the Temple — but God does not necessarily dwell there, and He may be approached and found quite as readily under the great vault of the open sky. More men have come face to face with God in the silent cloisters of their own hearts than ever found Him beneath the stone arches of a Gothic cathedral. That a beautiful Gothic cathedral may stir the emotions must be admitted; but such stirring of the emotions ought not to be interpreted either as religion or worship. It may serve as an acolyte for both.

Such buildings, with beautiful music and the rare

light filtering through stained glass, create an atmosphere; and for some people a proper atmosphere is a necessary concomitant of the act of worship.

Creeds and dogmas are a necessary part of religion; but we cannot lock the Infinite within the chambers of any creed, however comprehensive. Still, a creed is a necessity to prevent belief trickling away into the morass of loose thinking. Dogmas serve the same purpose. Many of them undergo modification in process of time. Only those endure which embody an element of hope; the rest tend to slip into desuetude and decay.

The religion practiced by a majority of our soldiers is one in which dogma has little place. They have a simple, rough-hewn creed of their own, which has not yet been reduced to the cold phraseology of written language. There are many exceptions, but for most soldiers religion consists in doing the straight thing, in never going back on a pal, in being a "white man" ready to deny and sacrifice oneself, even lay down one's life, for another, with no special thought of God at all. And yet, to limit their religion to these simple but heroic practices is to do them an injustice. Though they may not recognize it, and may not be prepared to acknowledge it, all this self-abnegation and lofty altruism is a ray caught from the cross.

Religion is not something to be clutched at with despairing hands, like a piece of flotsam, when the waters of affliction tend to overwhelm one, but an attitude of mind, an orientation of soul to be cultivated sedulously so that a man may walk with unbowed head through all the storms of life stayed by a glad confidence in the eternal justice and enduring love of God. Rightly practiced, religion is one of the chief factors in moral development, and without morality social progress becomes an impossibility. It acts upon moral develop-

ment from without by establishing a standard of conduct that makes for good; but its chief effects flow from its leavening influence within the heart of the individual.

Man's spiritual nature is the highest expression of his personality, and his religion is the atmosphere in which it flourishes best. That form of faith which makes a man the best citizen is the religion for him. It should help him to live in the atmosphere of the ideal, quickening him to compassion, filling him with a cheerful godliness and an unflinching faith in the future.

It should broaden his outlook and enlarge his horizon. Only when it becomes confused with a warping and rigid sectarianism does a man's faith narrow him. There is a type of religion which makes a speciality of the morose and impales every simple human pleasure on the spear-point of an isolated text. This is not Christianity, but the base coin of some lesser currency. The religion taught by Christ does not offer us position or wealth, but opportunities of service, and in loyal service no man fails of his reward. It makes a sacrament of the lowly task, it lightens the dark corners of the road, and turns the wayside pools into rich wine. It breathes into the soul the spirit of charity; and of charity the world has sore need, for every man carries his own load, every woman her own burden, and the road is uphill.

CHAPTER XVI

THE ADVENTURE OF DEATH

"My task accomplished and the long day done,
My wages taken, and in my heart
Some late lark singing,
Let me be gathered to the quiet west,
The sundown splendid and serene,
Death."

W. E. Henley. *Margaritæ Sorori.*

With the gift of life there comes to all living creatures a desire to continue to live. Among human beings this desire is only lost when they are plunged in the abyss of despair, and can see no gleam of light on their horizon. The desire to live is keenest in the young, old enough to see the panorama of life unfolding before them. Its intensity is the measure of their vitality. But, by a singular paradox, it is the young who are most ready to risk and, if need be, sacrifice their lives for others. Youth is the age of the generous impulse; few men are miserly in the spring-time of their days. That warped trait of character, if it comes at all, develops at a period of life when neither wealth nor length of days can be enjoyed to the full. But youth lives in an atmosphere of high altruism, and is ready to put all it possesses to the hazard if opportunity arises or need ever calls.

The desire to live is maintained all through life until old age, when in many cases it begins to abate, though some old people cling grudgingly to the last few grains of sand as they trickle through their weaken-

ing fingers, and never develop what Metchnikoff called "the instinct for death." It is only when death is recognized as inevitable that the desire to live is taken from most of us. This is a wise provision, for it makes death easier for the dying.

Life is a school of probation in which character is molded by experience and put to the test alike by joy and sorrow. But, for each of us, an hour comes in which we pass from the schoolroom of life through the portal of death into the unfathomable beyond. Death is no untoward accident, but as natural a phenomenon in the process of life as is the transference of a child at school from a lower to a higher class, when it has proved itself ready for the change.

If we could only bring ourselves to recognize this we should clarify our vision, and dissipate that dolorous fog with which superstition has beclouded the final act of life.

Death is as much a part of living as life is.

Elsewhere [1] I have endeavored to show that the fear of death is largely artificial; that the dying do not fear it when their hour comes; and that the act of death is a painless transition. At the same time I tried to prove that we have reasonable ground for believing that after death we go on.

It is not my intention to deal at length with these matters once again lest I should involve myself in vain repetitions. But there are two points which may be emphasized. When we have succeeded in reducing the act of death to its true proportions we shall cease to dread it, and shall shrink from it as little as we do from the duties that lie before us to-morrow. Indeed, we may do more than that. Stayed and armed by our philosophy or our faith, we may look forward to it

[1] *The Adventure of Death,* by R. W. Mackenna.

with intense but reverent expectancy, as the experience which is to usher us on to new and more fruitful opportunities. Many a man and woman has passed on in that glad confidence.

Many who believe in the doctrine of evolution find a difficulty in imagining that death does not extinguish us. To me this seems an illogical abandonment of their principles. If the evolutionary hypothesis is true, as we have very cogent reason to believe, man, as we know him, is the coping-stone of creative development in this world, built upon and from a foundation of lower forms of life. Man as a physical organism is a splendid product from such beginnings; but man as a thinking, conscious, reasonable, and moral being is a more splendid creature still. Character or personality, as met with in man, is a higher evolution even than that degree of physical perfection to which he has attained. It is the coping-stone in human development. But the loftiest human personality falls short of the ideal, and must forever fall short, and evolution as applied to the psychical side of life be an empty delusion unless personality survives the transition through death to continue further evolution towards the perfect ideal when it is no longer hindered and encumbered by the body.

However far reason or scientific knowledge may take us along the road of proof there comes a gap at the end which must be bridged over by an act of faith. For some the gap is so great as to be almost unbridgeable. For others it is so narrow that they can almost reach a hand across it to their beloved.

In all ages the seers and the poets, whose vision is clearer than that of ordinary men, have been the apostles of the belief in the immortality of man. It is a far cry from Homer and Hesiod to Tennyson

and Robert Browning, but through all the centuries that have intervened the witness of the poets has been a clarion-call summoning men to see and know that they are not creatures of a moment, but immortal souls.

"Plato, thou reasonest well.
Else whence this pleasing hope, this fond desire,
This longing after immortality?
Or whence this secret dread, and inward horror
Of falling into naught? Why shrinks the soul
Back on herself and startles at destruction?
'Tis the divinity that stirs within us;
'Tis heaven itself that points out an hereafter,
And intimates eternity to man."

CHAPTER XVII

THE MYSTERIES OF LIFE

"If I stoop
Into a dark tremendous sea of cloud,
It is but for a time; I press God's lamp
Close to my breast; its splendor, soon or late,
Will pierce the gloom: I shall emerge one day."
BROWNING. *Paracelsus.*

THE world is full of enigmas, and one of the greatest is life. We know neither what it is nor what its purposes may be, and we are perplexed by the mysteries which it enfolds. But the mysteries, and the difficulties, and the hard problems which it presents should impel us to seek earnestly for their solution rather than drive us into a backwater of indolent apathy. Half of life's allurement lies in its mysteries. If all the enigmas were removed it would be no more interesting than would be a game of chess in which every move is mapped out for them before the players sit down at the board. The existence of the human intellect demands the contemporaneous existence of mysteries — the knife needs the stone to whet it. Most thinking men will agree with Stopford Brooke, who said: "Few things produce more intellectual scorn in me than the impatience of the human race under enigmas. For my part, if life had no puzzle it would have no pleasure." [1] These are brave words, bravely spoken, but they do not help to elucidate the smallest of life's problems.

In those moments of arrogant impatience that come to us all we are apt to imagine that, if the ruling of

[1] *Life and Letters of Stopford Brooke,* by Lawrence Pearsall Jacks, vol. i. p. 234.

the world and the destinies of man were committed to our care, we could correct many abuses and set many a wrong thing right. We would be tempted to abolish pain and suffering, to blot out with a stroke all moral evil, to correct everything which in our puny way we think requires amendment, to clear away all the mysteries and make life as plain as a simple arithmetical calculation. If such an opportunity were given us our achievement would fall far short of our ambition, and it is likely that our fellow-men would be as little satisfied with our world as we should be with any world controlled by them. It is a mighty task to run a Universe, and something far beyond the power of any man. Most of us find the ordering of our own little portion of life a task more than sufficient for our talents. Let us leave the Universe to God.

But, dark and obscure though many of the problems which beset us on our journey through life undoubtedly are, they are not incapable of solution. Right at our feet, if we will grope and look, we may find a clew. Sometimes the clew is fine as gossamer, and now and then we lose it in the tangled and intricate maze of circumstances, but if we can grasp it and follow it we shall find that it grows stronger before our eyes until it becomes a cable strong enough to lift us out of the quagmire of doubt — tenacious as Flanders' clay — and set us with firm feet upon the high road to knowledge. The clew has its origin in Law, it ends in Providence.

We know how all the operations of Nature are conditioned by laws. No dewdrop falls out of the dark hand of night, no wave tramples with snow-white foot upon the shingle, no day breaks roseate upon the eastern horizon, nothing in the whole Universe moves, be it speck of dust or giant avalanche, except in obedi-

ence to natural laws. And what are natural laws? If we probe deeply enough we are forced to admit that they can be nothing else than the rules God has laid down for the regulation of His own acts. In this we have a demonstration of cosmic harmony. Man is a rational and intelligent being. A world in which caprice ruled instead of order, where season followed season in no regular succession but haphazard, where the sun and the moon and the tides obeyed no discoverable laws, but were the shuttlecocks of chance, would offer no field for the intelligent activities of man. Law in the Universe, reason in man: the two things are indissolubly linked together. Without the one, the other could not exist; without the latter, the former would be an unnecessary refinement. Part of man's life is lived in the physical world, and that part is never separable from the operations of law. And if we were not purblind we should see that all life is under law. The physical laws of nature are immutable; those other laws, as yet undeciphered and unknown, out of which spring all the enigmas and mysteries that perplex us, are equally unchangeable. The laws we have discovered and obey work to promote our happiness. In making ourselves their slaves we become their masters. Our greatest freedom lies along the line of obedience.

We suffer from breaches of the laws we already know; we suffer also for breaches of laws that are plainly written somewhere, but which as yet we have failed to decipher. This is a hard saying; but we dare not expect that fire should continue to possess its genial, heat-giving properties, without retaining the power of producing serious injury, until every child has learned that a flame will burn an inquisitive finger.

Some day perhaps, in the dim future, when man has risen to the full height of his destiny, the laws that are at present hidden from us will be found written in letters of blazing gold broad upon the forehead of everything that is at present a mystery. Until that day dawns courage should be the duty of man, and faith his watchword, for no mystery ever yielded up its secret to cowardice, and no obstacle was ever surmounted without hope.

Though life may be full of enigmas, perplexities, and puzzles, it is worth having in spite of them all. It is one of the tragedies of life, as well as one of its glories that none of us is asked if he will take it. It is a gift thrust upon us which we may not bury in a napkin, but which we must use. We may use it selfishly and make of it a desolate thing, or we may spend it in the service of others and cause it to blossom like the rose. But one thing we may not do. We dare not play the coward with it. If it comes to us laden with heavy burdens it is our duty to take it up cheerfully, and with a quiet and confident courage turn our face to the sun and set bravely out upon our way. The best lives are the burdened lives, if the load is not allowed to crush the spirit.

The world offers but few smooth roads to the traveler, and the level road is rarely worth while. The joy of overcoming the rough place is more than reward for the struggle. The Son of Man had blood upon His brow, but His feet were bruised as well. Few men are worthy to wear the crown of thorns, but the bleeding feet are a sign that we have not shrunk from the hard path, and along the hard path lie the best vantage points for seeing the City Beautiful. The roads in the valley are easy, and sheltered, and one may travel along them in a bath-chair;

only the rugged heights fling a challenge to man's soul, and only among their peaks floats the atmosphere in which his soul can rise to its true height. For life is no base and despicable thing, to be crawled through on our hands and knees, but a high adventure, to which we must answer on our feet, erect and proud. And if the way takes us over unfathomable gorges of doubt and despair, and leads us along the precipitous cliff-edges of mystery, there is no need for faintness of heart. Press on! The law of struggle is a law of life, and though struggle may mean pain and conflict, it has within it the seeds of victory.

What the purpose of life may be we cannot tell, but that it has a purpose we dare not doubt. It is such a little thing, only a span long, a mere atom in the immensities of infinite time and space, that it is hard to believe it can have anything but an infinitesimal significance. Yet without human life, and the mind which finds its vehicle in life, much in Nature and creation would be ineffectual pomp. Mind is at once the aim and elevator of life, and the goal of mind is God. But the finite cannot comprehend the infinite even though it looks with the eye of faith.

In the kingdom of the insects there are creatures whose whole life is bounded by the confines of a single day. They are known as the *ephemeræ*, and, born with the dawn, they live their little lives in the summer sunlight, hand on the heritage of life to others of their kind, and die when the night falls. One can imagine such an insect, hoary with all the hours of her brief life, gathering her children and her children's children round her dying bed, some broad-veined leaf, and seeking to make them wise with the fruits of all the philosophy she has gathered in the course of her long pilgrimage. Doubtless she can tell them how, in

the remote past, when she was a child, there was a mighty storm of wind and flood — some May vesper commingled with a shower of summer rain; and how, in the days of her youth, she narrowly escaped the voracious beak of some questing bird; and how, in the first flush of maturity, love came to her; and so on, through the whole gamut of her life's experiences. And, if she is an insect given to philosophize, we can imagine her pouring forth, for the benefit and guidance of her descendants, the cornucopia of her thoughts upon the world in which she has lived, and all its problems. The picture provokes a smile; but, in smiling, we are laughing at ourselves. Compared with the few brief hours of the life of an *ephemera*, our span of threescore years and ten seems an eternity. But the longest human life, and the most gifted human intellect, measured by the standard of infinite time and the infinite knowledge of the eternal Mind, are less in comparison than the length of life and the intelligence of the garrulous *ephemera*. So let us walk humbly, holding fast to whatever clews we may discover, straining with eyes of faith into the darkness, confident that some day and somewhere the clouds will be sundered by the light-bringing sword of dawn.

Within sight of the little bell-tent in which these chapters have been written stands a great city. Its streets are thronged by soldiers from all ends of the earth, for the curse of war is upon it. On the wine-dark sea, which washes its feet, war-craft come and go, and the drone of the humming aeroplanes fills the blue vault of the sky above it. In its streets vice walks openly and unashamed, and women, in whose eyes the pure light of heaven should gleam, leer evilly at men, at once their betrayers and their victims.

Lust and crime, sin and death, lurk in its alleys and by-ways. Nearer at hand, in long and serried rows, stands a tented hospital, where men, young and middle-aged, rich and poor, black and white, are suffering and dying to satisfy the blood-lust of the god of War. But, above all this vice-ridden and tortured city, over all the muddle, the filth, the folly, the baseness and inhumanity of man, there towers a symbol of the Divine. I know not by whose hand, or by what pious inspiration it has come to pass, but high on an eminence above the city is a church, and on its loftiest pinnacle there stands a gigantic, golden figure of the Holy Mother and the Divine Child. Far out on the deep the effulgent symbol may be seen by the harassed but home-coming mariner, and out of the mire of the city streets, if one lift one's eyes, it is always visible. This is the vision splendid; a perpetual witness to remind us that, though man make a mess of life and by the misuse of his talents and opportunities bring suffering and evil upon the earth, over all and above all there still reigns triumphant — God.

THE END

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